ELECTRICAL REVIEW

[ILLUSTRATED.]

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New Ohm-Meter.

A direct reading ohm-meter, simple in construction, and readily handled, has been a "consummation devoutly to be wished," and if the instrument here described and figured should prove to be what practical workers in the electrical field desire, no apology is required for introducing it to the public. The following is a brief description of a new form of ohm-meter illustrated by the accompanying engraving. The main feature and governing principle of the instrument is based upon the use of an annular magnet, such as are used in the construction of special voltmeters and ammeters constructed by the same inventor. In other respects the construction and arrangement is different.

The needle in this instrument is actuated by a current passing through a bobbin wound by two wires, in opposite directions. The two wires are so connected with the terminal binding posts—the central ones at each end of the base of the instrument—that the current used is divided, and one-half passing in a given direction around the needle; the other half passes in an opposite direction, exactly neutralizing the first, and the needle remains at rest. The plug in this case, is in the hole marked 2 in the engraving. If we then connect the two ends of the wire, the resistance of which is to be measured with the corner binding posts of the instrument, and put the plug in the hole marked O, a deflection of the needle follows, varying in amount with the resistance introduced. This deflection of the needle is, of course, produced by the difference of resistance of the two opposing wires. The deflection, however, does not give accurately at all the relative amount of resistance added. This is obtained by rotating the annular magnet—which is attached to the perpendicular spindle—until the needle is brought back to zero. The amount of rotation of the ring, as indicated by a pointer that moves over the graduated circle in concert with the magnet, indicates properly the relative resistance introduced.

The sensitiveness of the instrument is varied by raising or lowering the annular magnet. For instance, if when the ring magnet is lowered to its extreme limits, the resistance of one ohm should be indicated by one division upon the graduated circle; by raising it to the point represented in the figure, about ten divisions would represent the resistance of an ohm, and the sensitiveness would be increased tenfold.

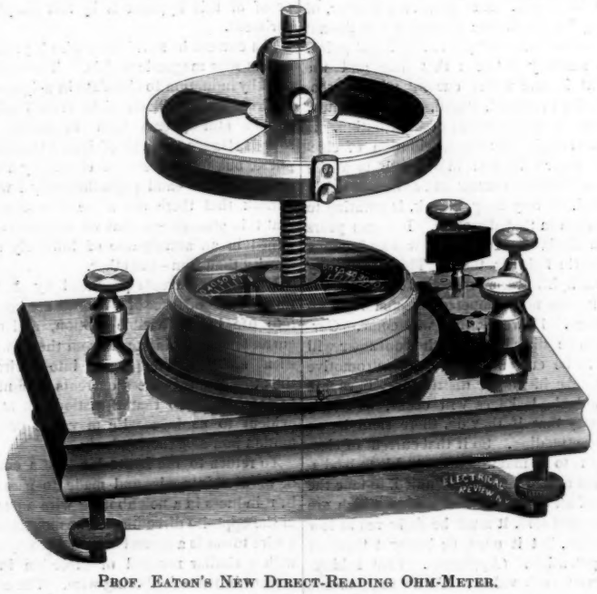
The same principle of construction may be applied to the mirror galvanometer, with greatly increased delicacy; and we should thus be enabled to dispense with an extensive and expensive series of resistance coils in ordinary work. The instrument figured is a small one of limited capacity, but they may be constructed to meet any given requirements.

It must be borne in mind that all steel magnets are liable to a change of moment and may in time require correction; but experience has thus far shown that the annular form of magnet is much less liable to change than any other. In case of any change by loss of moment these instruments are recalibrated gratuitously.

Prof. A. K. Eaton, of 65 Henry street, Brooklyn, N. Y., is the inventor and manufacturer of this valuable instrument.

Mather Company's Electric Light Plant in the Paper Mill of S. D. Warren & Co.

The largest paper mill plant in the world is illustrated in this issue of the REVIEW. It was installed in the large paper mill of S. D. Warren & Co., Cumberland Mills, Me., by the Mather Electric Company, of Hartford. The electric company furnished two 400-light incandescent Mather dynamos, and hung 900 lamps; also one 25-light arc Mather dynamos, with 25 arc lamps of 2,000 candle-power each. These latter lamps are used to light several of the streets of their village and one or two rooms in the mill; 600 of the incandescent lamps are hung in the several departments of the paper mills, 50 lamps in the stores, 50 lamps in the hall, 50 lamps in the church, and the balance of the lamps in several of the private residences belonging to the company. The power for the plant is furnished by two Buckeye engines of 75 horse-power each.



PROF. EATON'S NEW DIRECT-READING OHM-METER.

This plant, which, it is safe to say, is the largest one in any paper mill in the world, was started Jan. 21, 1887, and has been running in a perfectly satisfactory manner ever since.

An Earthquake in the West.

Illinois, Indiana and Missouri have been enjoying the sensation of a *bona fide* earthquake. About 4.20 on the morning of the 6th the Western Union operators reported that there had been an electrical storm during the night, between Chicago and Springfield, and at that time the connection was lost. A sleet storm was in progress at the time, and this had much to do with the trouble.

Springfield people were so shaken up that they left their beds; many people felt the trembling, and heard the rattle of chandeliers and lamp globes. The shock lasted about one minute, which the people say was plenty long enough, all things considered. Other towns in Illinois felt the disturbance, among them Centralia, Vandalia, Paris, Hillsboro, Champaign, Marshall and Albion.

In Indiana there were two distinct shocks at Terre Haute. The seismoscope at Rose Polytechnic Institute recorded the time as fifteen minutes and six seconds past 4 A. M. Vincennes, Petersburg, Bedford, Evansville, Sullivan and other towns felt the shock, and in Bedford, where plastering fell from the walls, clocks were stopped, and church bells rung, the shocks were ten minutes apart.

Manufacture of Copper.

According to a recent German patent, superheated steam is passed over copper sulphide, which is being heated to melting in a crucible. The steam is decomposed into its constituents, the oxygen combines with the sulphur, forming sulphurous acid, and metallic copper is produced, which, however, still contains a little protoxide of copper in solution. By stirring the mass with a piece of birchwood, complete reduction is effected. When the mass has been decomposed as far as steam will do so, no more hydrogen is evolved, and the flame due to the combustion of that gas disappears, thus indicating the end of the process.

An Electric Candle.

Mr. G. Ignatien, of Kiev, Russia, claims an electric candle for use with constant currents, and consisting of an inner carbon communicating with the negative pole of the dynamo or generator, and surrounded by a tubular or outer carbon of the same density as the inner carbon, and communicating with the positive pole of the generator, the relative sectional areas of the inner and outer carbons being adjusted in such a manner as to cause them to be uniformly consumed. The patent was granted Feb. 2, and is No. 1543.

Papers and Discussions at the Electric Light Convention.

DISTRIBUTION OF ELECTRICAL ENERGY BY MEANS OF SECONDARY GENERATORS.

The Very Interesting Address of Dr. Otto Moses on the Above Subject.

THE DISCUSSION WHICH FOLLOWED GIVEN IN FULL.

The closing session of the Philadelphia Convention of the National Electric Light Association, Thursday, Feb. 17th, which was reported in substance in our last edition, comprised many interesting features. Following the excellent paper of Mr. Ball, which we have published, came discussion as follows:

THE PRESIDENT: Mr. Ball, by the time you get to the motor only 5 per cent. of the initial pressure is left?

MR. BALL: I have not gone over the figures carefully, but I think the figures will show that 5 per cent. is as much as can be realized in the way of electrical energy.

THE PRESIDENT: What I am trying to do is to put the loss on your side of the house instead of ours. There is a loss; now where is that loss?

MR. BALL: That loss is in the apparatus.

THE PRESIDENT: How much do you lose between boiler and engine?

MR. BALL: The whole loss before you deliver the power to the dynamo—.

THE PRESIDENT: What I want to get at is the loss from the boiler to the engine. Mr. Sprague yesterday made the declaration that the steam used by the New York Steam Heating Company when it was delivered to the engine was wet steam and that you could not get more than 75 pounds pressure. I cannot go into that question far enough to make my case as clear as perhaps some of these other gentlemen, but I assume you have got a loss between boiler and engine of about 60 per cent. of the heating power of the coal.

MR. BALL: Yes, sir; but I mean under the most favorable circumstances; having the engine standing next to the boiler—.

THE PRESIDENT: What is the loss?

MR. BALL: Probably not over 75 per cent. of the heat energy of the coal is absorbed by the boiler. There is a loss of 25 per cent.

THE PRESIDENT: How much do you lose between that and the engine?

MR. BALL: Well, the best forms of steam engine only convert a very small percentage of the heat energy into dynamic energy. The rest goes out of the exhaust pipe; so that the amount that is really utilized of the heat energy of the coal is considerably less than 10 per cent.

THE PRESIDENT: That is, you lose about 90 per cent.

MR. BALL: I think over 90 per cent. of the energy of the coal is lost.

THE PRESIDENT: Now, Mr. Ball puts it

this way. That under the most favorable circumstances you can only reproduce about 5 per cent. of the initial heat energy of the coal in the dynamo. Now, if you walk out of the door of this Convention with that declaration ringing in your ears you will say, "I don't want any dynamo in mine." The same will apply to running a flour mill or cotton mill. That is to say, it is the fault of the engine, not the fault of the dynamo.

MR. BALL: That is right, sir. But I did not say you would realize only 5 per cent. in dynamic power; I said in the final electrical result; because it is known that the dynamo delivers nearly the equivalent of the power produced by the engine.

Inquiry was made by Mr. Wetzler concerning the engine improvements mentioned in Mr. Ball's paper, to which Mr. Ball replied: This is hardly the place to advertise one's wares, and perhaps I have done more than I should already. I shall be glad to talk to the gentleman in private.

The secretary read a communication from Mr. C. W. Price requesting the members and guests of the Association to register their names in a book provided for that purpose at the parlors of the ELECTRICAL REVIEW, in the Hotel Lafayette.

An invitation was read from President H. C. Davis, of the Electric Club of New York, inviting delegates to the Convention to dine with the Electric Club at the Hotel Dam, New York, at seven o'clock that evening. On motion the invitation was accepted.

MR. DECAMP: I wish to offer the following resolution:

WHEREAS, It is not possible for the accounts and bills of the Association to be audited and the financial condition of the Association reported to this meeting, be it

Resolved, That the Executive Committee be authorized to pay such bills as may be incurred by the Association.

The resolution was adopted.

THE PRESIDENT: The secretary will read a communication from Mr. Charles S. Van Depoele on the subject of motors.

The secretary proceeded to read Mr. Van Depoele's paper, but was interrupted by the President, who said: The paper seems to be too much in the line of advertising a certain specific class of machinery.

Dr. Otto Moses, of New York, was then called for and addressed the Convention, without notes, on the subject of

THE DISTRIBUTION OF ELECTRICAL ENERGY BY MEANS OF SECONDARY GENERATORS.

Mr. President and Gentlemen of the National Electric Light Association:

There is an old French saying which goes thus: *Qui s'excusé s'accusé.* Who excuses himself accuses himself. I come before you without a paper. I have been announced as being about to read a paper on the "Electrical Distribution of Energy by Means of Secondary Generators." It is a very tempting thing to sit down and collate. It takes some little trouble to go off three or four hundred miles for the purpose of looking at that which has been described nicely in print. But I thought before expressing any views on this subject to this Convention (which desires practical facts and not scientific theories), I would go to the only point in the United States where absolutely accurate information might be obtained. I have just returned from Pittsburgh, where the electrical distribution by means of secondary generators has been put into active and successful operation, and later in the course of my remarks I will give you the result of my observation there. It is necessary, however, for me to premise by stating some of the conditions under which secondary generation must be employed.

The excellent paper that we have just listened to points out one of the difficulties, and it is a great one, in the way of the proper distribution of electric currents, and Mr. Sprague yesterday spoke in the same vein of the great difficulty of running motors and electric lights on the same circuits, and it impressed me very much.

Now, to distribute current from a central station means to give what is wanted *when* it is wanted. As during the night hours there is very little demand either for light or power, it is evident that during the time in which energy is not being generated the commercial value of the investments for producing electrical currents are not being utilized. (Applause).

I would suggest now that this is the pivotal point upon which all discussion must turn.

When Mr. Edison started that large central station in New York, he laid down this general commercial principle—that when a thing is wanted you must be able to supply it; that there is no use in supplying it until it is wanted. I think there he made an error, not in the general statement, but in the fact that he came into a city for the purpose of providing only what was wanted by a narrow district of that city during but a small portion of its daily life. Now, that city is a unit. Were he supplying current from a central point to many districts there might be times where certain appliances would come into play by which his current could be constantly produced and utilized, but as he went into a city for the purpose of distributing electric current he should have considered all the wants of that city, and also that during the night hours there is no demand for electric current. Now, the conclusion to be drawn from this statement is that superfluous current would have to be stored or not produced. It is necessary that it should be produced in order to utilize a plant to the utmost. Therefore current must be generated and stored in places where the investment in land and realty for the purpose of keeping that current in available position would be brought down to a minimum. That, to my mind, can only be done when introducing currents from a great distance from a city. It means, further, carrying your source of production to the place where the chief element of the production is to be found. But that is a matter, of course, for the future; perhaps not a distant one, but we have not yet reached that point. Still, midway between that time and the present is one where current will be economically produced, stored, and distributed.

Now, as to the method of distribution. If a central station for the distribution of electrical power is located in a city, it is a *sine qua non* that the current must be one safely handled. Everything, I think, is pointing to legislation in that direction. It began years ago in England. It, in fact, was an incubus to electric lighting there. The reason why electric lighting has progressed in America is that it was not hampered by such legal restrictions. However, that will come. Currents to be distributed to the consumer will have to be currents of low electromotive force. Accidents to distributing lines are unavoidable, leakages will occur, and it is necessary that if they do, there shall be no danger attending. So if that current of electricity is to be manufactured and is to be distributed and to be safely handled, to take the place of all other forms of energy which are bought and sold, it must be delivered at low potentials, but it must be brought there at high potentials. (Applause). That, I think, is almost self-evident. To do that, means that you must have a current sufficiently high in electromotive force, to bring enormous quantities of current over small conductors and then to transform that into currents of lower electromotive force that are safe to handle. That problem has been attacked and it has been solved.

Now, gentlemen, before going to the heart of the subject it is necessary, I think, to go over some beaten ground, in order that we may have a clear conception of what this distribution of energy by secondary generators is, and for that purpose I must make a little historical resumé.

Faraday, whose name I believe, makes a reverberation in every electrician's heart, was the man who first attacked the problem of the induction of electric currents. The seeds of it had been sown before by Barlow, Christie, Herschel, Babbage and Arago, particularly. From their first experiments he cultivated a most magnificent outgrowth of science, and out of his deductions and experiments others grew. That is the course of all science.

Out of the experiments of Faraday came the laws of Lentz, and it is necessary for me to call attention to one of them in order that the silent working of these powerful secondary generators should be made quite clear to your mind.

You all know that if a current of electricity be made to circulate in a wire it will nduce currents in all neighboring objects—not necessarily wires. If, however, you bring another wire near it, it will be possible to distinguish the action of the current upon that wire by suitable instruments. The fundamental experiments may be recalled here. A current was made to circulate in a length of wire and wrapped in close proximity to it—these are the classic Faraday experiments—wrapped in close proximity to it was another wire in whose closed circuit was intercalated a galvanometer. The closing of the circuit passed a current through the first wire, and simultaneously with the closing of the circuit, a current was induced in the neighboring wire, its action being made visible by the motion of the galvanometer needle. Now, that looks like a very simple experiment when made to-day, but it was the result of a very profound deduction. It was based upon this experiment, familiar to you all, because exhibited in every dynamo machine, that is, if a wire is put in motion between the poles of a magnet, currents of electricity are generated in that wire at right angles to the direction of the lines of force in the field. In this case we see the motion of the wire is the cause of the induced current. But it was a magnificent conception; it was that it is possible to produce an induced current in a wire without giving it visible motion. The whole fabric of the modern theory of the conservation of energy and the correlation of natural forces arose like a vision before the mind of Faraday on the successful proof of this hypothesis by this simple experiment.

If a current be sent into a wire it produces in that wire magnetic whirls. Those whirls tend by induction to circulate in neighboring bodies. They will circulate more freely in certain atmospheres than in others. It sounds strange to speak of iron as an atmosphere, but for currents of electricity iron is an atmosphere—and parenthetically I would remark that there are some who conceive that this atmosphere that we breathe is contained in an atmosphere of infinitely more density than iron—the ether.

Now, the currents produced by the cutting of lines of force of a magnet are brought into life by the visible motion, and other currents may be induced from those, whose silent and invisible passage into a wire, on the other hand, induces currents in a neighboring wire. So that a motion not at first evident to us in a wire may still produce motion in a neighboring body.

To return to the Lentz laws—if a current be induced into wire and made to pass over it, it induces in a neighboring wire a current in the opposite direction. The movement of a wire towards a second wire is accompanied with a similar reversal of direction in the current in the neighboring wire. The carrying of it away induces a current in the same direction as the one circulating in the main conductor. Now, it matters not whether we bring the current up bodily by an exertion of our power which is visible to us, or whether we bring that current up by any other chemical power than that of life—say from a battery—we bring it up from an infinite distance into that wire; the results are the same, a current is induced in the second wire. The instant, however, that we stop the motion of that first conductor, that instant the induction in the other seems to cease—it does cease. That is a very remarkable thing, and on that is based the action which enables us to use secondary generation for putting all electrical machines in motion. All the grand results which I will describe to-day in the distribution of electric energy by means of secondary generation are found in those germs of Faraday which he planted for us; but, like germs, they contain in their smallness the very perfection of greatness. They are small beginnings from which great things have come. How important is it, then, that the germ should be perfect in order that the luxuriant tree may be perfect, since the one contains the other. Faraday's, experimental researches contain the whole pith and essence of what we do to-day. Still those were scientific facts; the practical applications of them are what concern us most.

The fundamental experiment of Faraday, of wrapping a closed ring of iron with a wire and passing a current through it, thus inducing other currents on the same closed ring of iron, is the basis of the secondary generator. Modifications of that, innumerable, will be made in practice; but those are the fundamental scientific facts. For the field of science is very much like the field of nature, which has to be cultivated and often planted out with exotic growths before man can feel the value of it, and prove its adaptability to his needs.

About 1882 Lucien Gaulard, of France, undertook to utilize this scientific fact and endeavored to transform currents of electricity from one potential to another for commercial purposes. That fact had already been made use of in the inductorium for scientific purposes. As you all recollect, the induction coil consists of an iron body around which two coils are wrapped through one of which, called the primary, a current is sent and an induced current is produced in the second wire adjacent to it. Now, that fact is known. It was applied. The instruments for making these transformations were brought to the highest state of development, yet one circumstance connected with the use of them was not known or tested until Gaulard and Gibbs commenced their investigation. I will refer to what that fact is.

In these inductoriums of which the Rhumkorf coil is a type, currents have been invariably sent through primary coils of copper wire of large dimensions, and currents have been induced in corresponding coils of small dimensions, and the resulting currents have in that way been enormously increased in electromotive force.

Is it not a wonderful fact that the reverse of that process never was done? One of the largest inductoriums in the world was that belonging to Mr. Spottiswoode—a man of great scientific attainments who occupied the chair of the Royal Society, a most inveterate experimenter, a very wealthy man, and consequently able to carry his experiments to any pitch of development. It consisted of nearly 300 miles of wire of fine dimensions wrapped on a primary coil of some 1200 feet in length. He produced sparks from that machine that would be instant death to anyone who took them through him. He handled those machines; he passed strong currents from a De Meriten's alternating current magneto machine through coarse wires and yet never passed a current through the fine wires. Now, that looks like something very unaccountable; although it may be explained by the supposition that he was fearful of injuring the insulation of his fine wires by the currents; but there is no record as far as I now know—and I have investigated the subject—there is no record in which a current of electriciy in a Rhumkorff coil was ever made to pass first through a wire of fine dimensions in the neighborhood of one of coarse dimensions. Now, M. Gaulard, long after the Paris Exposition—two years—(a long time in the history of electric lighting) undertook to do that and did it successfully. The result was that he was able to transform commercially currents of very high electromotive force into currents of very low electromotive force, and that is the solution of the whole question of the transmission of electrical energy from a distance.

At our last meeting in Baltimore I took occasion to refer to certain periods of development that have occurred in the history of electric lighting. I spoke of a period not then present, and I called it "the coming period." I say to-day, in view of what I have seen myself in South Pittsburgh of the distribution of electric energy through secondary generators, that it is not to be called any longer the coming period, but the period that has come. I will now proceed, gentlemen, to tell you what has been done there.

The entire paraphernalia of enormous

steam generators and engines, dynamo machines, with complicated commutators, and all the accompanying materials necessary to indicate the strength of currents that are now used in cities for isolated lighting—all that will be done away with, and the electric lighting interest to-day, will be as I have seen it there, a system of electrical distribution ready to be applied by the Westinghouse Electric Company, of Pittsburgh, and every consumer of incandescent or arc light. We know that the dynamo of to-day which is in almost universal use is the continuous current dynamo. That has been the machine from which all our electrical energy is produced. You know the dangers of it. The dangers are not those of high potential, but of disarrangement. The commutator of a dynamo machine, as we know it, is a complicated piece of mechanism. It is that weak spot in the system that you all have recognized. To go into a central station and watch the care that men take of those little sparks that begin to form upon the commutators—to see their nervousness under the knowledge of the absolute impossibility of stopping the work, and that they have got to get rid of that corroding spark while the machine is in motion, causes us to say that any substitute for a continuous current machine and a commutator would be a good thing. But what a fortunate thing it is that in this new distribution of energy the commutator which is the weak part of the dynamo machine is entirely put aside as such. In a system of distribution by continuous current dynamo machine, the direction of your currents (which are originally alternating) must be changed by means of a commutator. In a system of secondary generation where currents of opposite polarity are induced, there is no necessity to alter the direction of that which you want to retain. The result is that you take the currents from the commutators, or collectors as they should be called, directly as they are produced. There is no necessity to straighten them and to change their direction.

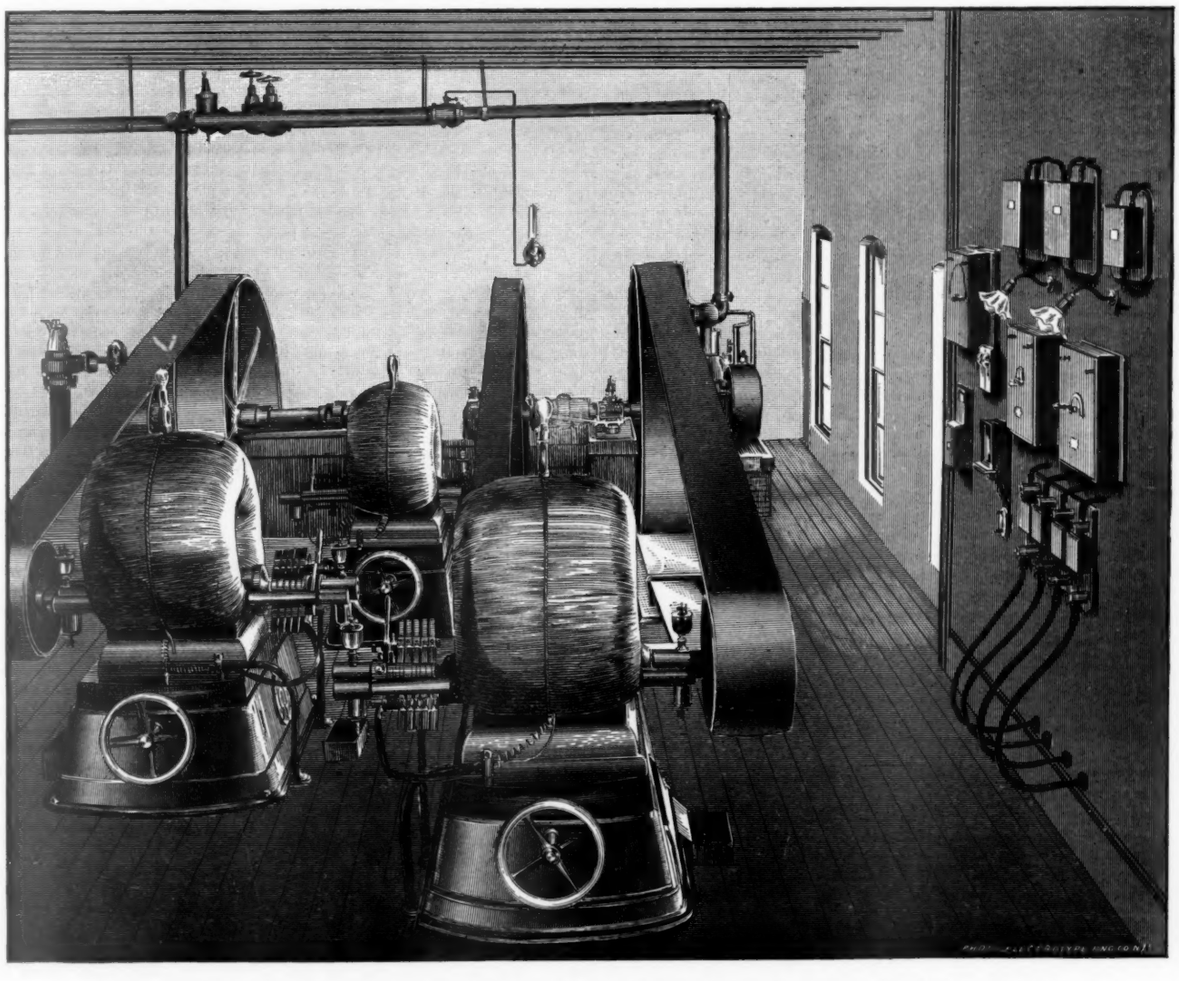
Why was not that done before in incandescent lighting? On account of popular prejudice. People have said that the current from an alternating current machine is an unsafe one. Well, if you look at the spark that is produced when you turn off say fifty incandescent lights on an alternating current machine you will find it not to be any greater than the spark produced from a continuous current when you turn off one light. Now, the limit—I say this with all deliberation—the limit of 100 volts electromotive force to the distribution of electric current was caused by the fact that the spark produced on the rupture of a current of 100 volts electromotive force was so great that if they had made that electromotive force greater it would not have been possible to turn on or off an incandescent light. Now, we may look for very deep motives for the selection of 100 volts as the electromotive force in prevailing systems of distribution; but here is the truth in a nutshell, and it is a beautiful fact, that the alternating current of 100 volts when ruptured does not produce that continuous arc that you get between the terminals in a continuous current machine. That is a trifle, but like that great man who, when some one visited him in his studio and accused him of having been idle, said: "Why, I have been at work." "Well, you have done nothing." "Yes," said he, "I have labored a little here and a little there." "But," said the other, "those are all trifles." "Yes," said the artist, "but the trifles make perfection; and perfection is no trifle." So may I say, these little things go to make up that which we call success or failure in a system.

I recollect having once called your attention to the fact that the similarity of the coefficients of expansion of platinum and glass was at the bottom of the possibility of incandescent lighting. Here I remind you of another important fact: that since the alternating of a current produces on the rupture of the current so small a spark at the contact key or switch, you can use a current of much higher electromotive force without those great dangers from fire that come from breaking currents of low electromotive force. (Applause).

Now, while proceeding to that which I think will interest you more practically—an alternating current machine is one that is easily manufactured. All the mechanical difficulties seem to be eliminated. You have simply masses of iron. Massive coils for commutation will interfere with the proper working of a system. These producers of currents can be manufactured at the lowest prices. I think, as I have said years ago, that the day will come when we shall be in a position to box up a negro with a dynamo-machine and send it off, meaning by that that there will be no necessity for any particular attention to be paid to the sparking of commutators. It has to be watched now very carefully. In the alternating current machine you are not made to see the inversions of the current—and you have none of those anxieties that come from the use of continuous currents.

Follow me for a moment to the station in South Pittsburgh for the distribution of current by secondary generation and we will find everything reduced to the simplest. First we have a tractable source of power. In Pittsburgh I saw it in its perfection. We see a beautiful clear light given under boilers—natural gas being perfectly burned; heat produced, almost without any appearance of the cause of it; a gentle glow that may be called the beau ideal of power in action, a source of power self-regulating. In the boilers that I saw in Pittsburgh natural gas was everywhere being used for the generation of steam. The gas is brought to the boiler; a current of steam is made to counterbalance the pressure of the gas, and as the variation of the pressure of steam on the diaphragm is made to operate the valve of the gas supply pipe, a perfect regulation within one pound of pressure on the boiler is produced. Here is one great source of anxiety eliminated. The power is now transmitted to an engine—such a one as that we saw last night operating a lighting station in this city—one of the Westinghouse engines, which are so simple in their character that I am told they will run for a year without being stopped—another source of anxiety eliminated, to any one who has ever had the misfortune to run a very high-speed engine of a certain type. (Laughter.) The power is distributed from that self-regulating steam engine directly to an alternating current machine of 1,000-light capacity. The sparking which comes from a continuous current generator of large proportions is wanting. In the present state of the art, for convenience sake, an exciter for the alternating current machine has to be used, although it contains this defective commutation that we speak of.

But the day is not far distant (and I would like to be put upon record here) when alternating current machines will regulate themselves with the most perfect regularity. There will be no necessity to excite the fields from separate machines; and, although an alternating current is supposed not to be in that condition to produce a uniform field, still it will be possible to do it without any of the difficulties of hand regulation that attend the formation of the field at present. But that is a minor difficulty, which is of little importance at present. The currents produced in these alternating current machines now are made to circulate through a main wire three miles long, running a mile and a half out and in from the cen-



VIEW OF MATHER ELECTRIC LIGHT PLANT IN PAPER MILL OF S. D. WARREN & CO., CUMBERLAND MILLS, ME.—(See first page.)

tral station. As it circulates it is made to pass over closed magnetic circuits, which are in multiple arc across the main line. Here another wonderful fact comes into play, and I must call your attention to it, in order that its importance may be properly understood. If an incandescent light is put across a circuit, the current that passes is regulated by the resistance of this multiple arc branch. If you increase the size of the bridge over which this current passes you get a corresponding increase in the quantity of current passing. Therefore, in an incandescent light distribution there should be a current of one constant potential, and each bridge should have the same dimension as its neighbor in order to maintain a uniform distribution. Now, if a current is made to circulate around a closed magnetic circuit (which is in reality a part of the original circuit) a counter electromotive force is started up which prevents the consumption of current—the reverse of the case of the incandescent lamp just cited. That is a fact that I never cease to wonder at. I bow my head in perfect bewilderment over it, considering how little it was understood in the first attempts that were made at distribution of the electric energy by secondary generators, and how absolutely essential it is to a successful distribution. There is a multiple arc circuit, and yet no current, apparently, being produced in it. Yet, if you put a lamp in a multiple arc circuit you will get current passing in proportion to the size of the bridge. How wonderful the influence of the closed magnetic circuit in its reaction on the electrical one. In generation through transformers it makes no difference whatever what may be the size of the conductor you employ; in multiple arc around the closed iron ring no current seems to circulate. Without that fact it would be impossible to distribute electrical energy by means of a secondary generator, because a multiple arc arrangement is very necessary for the proper utilization of current. Once we have the current supply, though we may not use it, we may have a valve by which it can be turned on when desired. Such a valve is our incandescent lamp, arc lamp, meter, or other translating device. By these valves current will be turned on in proportion to the quantity of electric force that is needed—another very wonderful fact, apparently a trifle, but of supreme importance in the future development of electric distribution. Though the Westinghouse system of electric lighting draws its supplies from innumerable roots, coming from all directions, each one doing its essential work, and in the aggregate producing the perfected fruit, yet the above fact is the very tap root of the whole matter. Now, a current being produced in our main circuit a secondary current of varying potential is produced in the other and neighboring circuit, such scondary current depending wholly on the diameter of the wire. It is possible to so raise the potential of the primary circuit as to give you any quantity of current that you may choose to develop in the secondary one. It is simply a question of raising the electromotive force of the primary currents—a matter that is easily regulated at present, in this distribution that I speak of in Pittsburgh, where the exciter regulated by the engineer is made to throw in more or less current into the magnet coils of the alternating current machine, thus strengthening or weakening the field, and in that way compensating for the amount of current consumed.

Here we have a source of electrical energy completely and economically at command, and it is only necessary to apply to it all the translating devices now in use or that hereafter will come into use, and you can get any form of current—any potential—any quantity, for any purpose. It will be possible too to so change the direction of the alternating current that you will be even able to make electric depositions by it. You will be able to get off continuous currents from alternating currents, so that there is no use for electricity which will not find in this method of secondary generation a suitable means of application.

But one further point I would like to call attention to, for the reason that I see in it the solution of the production of all forms of force that are to be utilized by the hand of man. At present if a current of high electromotive force is sent over secondary generators it must not surpass certain potentials. As Mr. Sprague said yesterday, 3,000 volts is just about as much as he wants to handle. Deprez has gone up to 7,000, I think. Gentlemen, I confidently predict the day is going to come when we shall use currents of a potential of 20,000 to 30,000 volts. (Applause.)

At first sight one would be disposed to say—why, there is no machine that will stand it; the self-induction that takes place will destroy the insulation. I reply: It is simply a question of insulation; a question of cheap insulation, because in a good Rumkorff coil we can get currents of 20,000 or 30,000 volts electromotive forces without danger to the insulation. It is simply a question of cheap insulation. Now, where have we to look for cheap insulation? Let me stop a moment to take a draft of cheap insulation—there is any quantity of it around us. (Applause.) There is no better insulator than the air we breathe, nor is there one that costs us less.

How are we going to use air as an insulator? Why, you say, "to generate currents of high electromotive force from a moving conductor you must have high insulation. You cannot put the turn of your coils so far apart that they will not be sparking from self-induction." I say there is no necessity in the world for you to have a moving coil. I call your attention to the fact that the whole theory of the secondary generator is the introduction of a current from a distance, moving with infinite velocity from an infinite distance, and that produces the motion; we do not see it. Now, then, for the solution of this difficulty. Let us produce currents of exceedingly low electromotive force that require no very fine insulation to prevent their escape or to avoid personal danger, and then let us transform those currents of low electromotive force into currents of high electromotive force, which can be done, as you see, with the greatest ease, but let it cross an air insulation, and then we will be able to produce currents of 20,000 to 30,000 volts electromotive force and to conduct them to another point; we may then transform those high tension currents into currents of low electromotive force. Begin the current at 50 volts, transform to 50,000, and re-transform gradually from 50,000 to 5,000, to 500 down to 50, at the point of consumption, if you please. It can be done with very little loss, and this is the point that I want to call to your attention especially, that the outcome of exhaustive experiment is a demonstration that by transforming currents of high electromotive force into currents of low electromotive force proves there is a loss of less than two per cent. in that transformation. Now for a practical application and suggestion. Go, for instance, to Pittsburgh, Buffalo,—wherever there is natural gas, or coal, or water power, slack heaps—Niagara Falls, if you wish (I take issue with Mr. Sprague on this: Niagara Falls is going to be one of the grandest sources of power that ever was conceived of; it was put there by the hands of nature to be utilized; it was brought from a distance to be used at a distance;. (Applause.) Go, I say, to the source of power; let us take it a little nearer home at present. Go to one of the greatest sources—natural gas; generate your electricity there at low potential, which is very easily done, and then transform it into currents of exceedingly high electromotive force, and conduct them along, as I once heard Mr. Frank Pope, of New York, say very pithily—"conduct them along a dead line;" that is to say, purchase a right of way from the natural gas down to the seaboard; put there your currents of what electromotive force you please, but take care of them; don't go near them. (Laughter.) There is no necessity to go near those wires, any more than there is a necessity to walk on a railroad track. Generally the tramps do that; no reasonable people walk right on the railroad track. (Laughter.) Keep off it. I do not think there is in this room a gentleman who has ever climbed an electric light pole here for the purpose of feeling whether the current was passing through an arc light wire or not. (Laughter.) There is no necessity for it. Keep away from those currents. Transform them on one side of a wall, and take them off through a wall. Suppose there was a Herring safe on exhibition full of dynamite; why, I would have no hesitation in the world in taking my wife and children and walking around that safe, and admiring the outside of it; but I would not open the door and walk in to look at the interior or to handle the contents. (Laughter.) I say, take your currents of high electromotive force, and envelope them with the equivalent of these massive iron walls—envelope them on iron walls, too, but carry them to a point where you will take them through iron walls safely. By induction in secondary generators and transforming your currents into currents of low electromotive force, use them for any and every purpose.

That, gentlemen, is the solution of the question. You will find wires of moderate dimension bearing power of unlimited quantity. I have said at tensions of 20,000 or 30,000 volts. There is no reason why on a straight conductor we could not take a current of 100,000 volts safely. There is no scientific reason, and there will soon be no practical reason, why we should not. Therefore, I look to see the day—I won't say before I am much grayer, but before I am very much older—I look to see the day when power can be brought from Niagara Falls, in spite of certain calculations that I have seen made on that subject. A gentleman present knows to what I refer.

Now, gentlemen, I have occupied your time, I am afraid, too long, and there are persons here who have given this subject some attention, and I would ask the President to call, perhaps, upon Mr. Slattery, who has investigated the subject somewhat, and let us hear what he has done in that direction.

I would like to say one word more before closing. It is good to give honor to whom honor is due; and although Faraday is the one who first discovered all these facts, and applied them in a small way, it is necessary to call attention to the name of one or two of those who have investigated this matter, after it had been applied practically by Gaulard & Gibbs, and who have tended to give it great value. I refer to Rankin Kennedy, of Edinburgh, who, seeing the difficulties that were in the way of transforming that energy, suggested that that which was before used for incandescent lighting—the multiple arc system—should be used for the transforming of currents, and Dr. John Hopkinson and Messrs. Zipernowsky, Deri and Blathy, who also subsequently engaged in the practical introduction of Gaulard & Gibbs' inventions for the transformation of electric energy from conductors at high potential to conductors at low potential, for commercial purposes.

MR. MORRISON: (Vice-President Weeks in the chair.) Dr. Moses, let us ask you a few questions about this business before you go away. Was the system that you saw in Pittsburgh similar to the experiments which we witnessed last night?

DR. MOSES: Oh, no; those were very crude experiments.

MR. MORRISON: Was it on that line?

DR. MOSES: On the general principle of the transformation of currents of high electromotive force into currents of low electromotive force by induction. Through the kindness of Mr. George Westinghouse, of Pittsburgh, I had the privilege of examining certain of his transformers, and as there were certain things that could not be given to the public in connection with them I was asked not to speak too particularly about them. But I assure you, gentlemen, that there is no difficulty and no danger to the converters.

MR. MORRISON: Was the system similar to the one we saw at the electrical station we visited?

DR. MOSES: No; that is one very much like the systems of distributing incandescent light that are generally used throughout the world at present. That a very good system, but the other is so far in advance of it that I think if the gentlemen who have that station in there had an opportunity they would be very glad to take it out and throw it on the waste heap and put in secondary generators.

MR. MORRISON: Mr. Weissleder requests me to ask you what about the armatures of the dynamos used in that case.

DR. MOSES: The armature in the dynamo machine that is at present used is one of exceeding simplicity.

MR. MORRISON: How does it last?

DR. MOSES: I have seen them working right straight along, and if the thing works well once there is no reason why it should not work well twice.

MR. MORRISON: That is no argument why it should work continuously well; it may wear out quickly.

DR. MOSES: There is nothing in it to wear out.

MR. MORRISON: No metal in it?

DR. MOSES: There is metal in it, but that does not wear in its friction through the magnetic field. The making of a dynamo machine is simply a question of proper insulation.

MR. MORRISON: How does the insulation stand?

DR. MOSES: Well, from the nature of the construction of this machine I would say that it would stand it admirably well.

MR. MORRISON: How does it stand? How long has the apparatus been in operation?

DR. MOSES: There is present here a gentleman—Mr. Duncan—who is largely interested in electric lighting, and by the by, if you will allow me to say parenthetically—while I was in Pittsburgh I visited his central stations. They were very remarkable stations. They were like cocoons, one within the other, and he has investigated the subject, because, as I understand, he has the complete control of the distribution of electric light, according to that system, in Allegheny county, and he would therefore be the most proper person to speak about these questions of duration, since he is upon the field itself and controls it upon the very point where it now is in operation; so that for those questions of durability, I will have to refer you to this gentleman.

MR. MORRISON: The only reason why I asked these questions, doctor, is because you have made specific declarations in regard to the value of this system, and what I want to find out is what you have to base them on.

DR. MOSES: Well, I have corresponded on the subject, and I find, for instance, that so satisfactory is the system that at the present moment they are introducing in Rome a distribution from a central station that will distribute 20,000 incandescent lights on that system of transformation or a similar system of transformation.

MR. MORRISON: That is what they are going to do?

DR. MOSES: They are doing it now. They are distributing 6,000 lights.

MR. MORRISON: In starting out with your speech you said something about going upon the authority of correspondence, compilations, etc. What I am trying to get at is what you actually saw in Pittsburgh, how long that had been in operation, and what were the material facts. When you go into a room that has a very dirty floor and the illumination is exceedingly brilliant, you do not notice the dirt on the floor, and listening to you with your splendid oratorical powers, I do not want them to have their eyes blinded as you go along. (Applause). I am like the man on the fence. Certain things, you declare can be done; you have seen them done in Pittsburgh; they are doing it in Rome, you believe. You know what I was going to say last night to the Julien battery men? Well; consider that said.

MR. DUNCAN: (Interrupting). I would like to know whether Mr. Morrison is addressing Dr. Moses or the Convention?

MR. MORRISON: I am asking questions, Mr. Duncan, of Dr. Moses, by permission of the chair. (Applause). The man on the fence listens to all the propositions and then he says: How are you going to do it—this

high electromotive force business, induction and all these things? A man may say it is possible for a man to balance himself in the air the same as the birds do. How are you going to do it? Why, fly, the same as birds do. That is the way with all these things; and I want to start a line of questions, Mr. Duncan, to determine the value of this thing. We have seen grow up amongst us a whole lot of promising electrical schemes, and we have found that when practically applied they did not produce the results which were expected. That goes all the way from the Brush electric light system (which is, I assume, the best one, taking it all around, that has ever been introduced) down to the last invention, whatever that is. Now, what I want to get at in this case in regard to the distributor is—what have we to go upon? How long has it been in service? What information did you obtain from your personal observation, as to the life of the apparatus? Its efficiency you have already given us. Its life is one of the main questions; because in that case if you have to renew, as in the storage battery, it would cost you $1,800 to make a battery for 250 lights, and that battery burns out in six months. The light is all right, but where is the fellow who runs it? He is in the poorhouse in a little while.

Mr. Weissleder: I would like to ask a question which may bring out an answer to your question in part, as to how this is distributed—how to prevent loss. I presume that I could make myself clear, or rather make the question comprehensive, by making a diagram on the blackboard, and I will attempt to do so. Now, we will suppose there is to be a wire on which there is a current of high tension. (Making a sketch). I understood Dr. Moses to say that a high potential current passing over this wire produced a current in neighboring bodies. Now, it may be that it is possible to obviate that by wrapping the conductor carrying the high potential—by wrapping on the outside of the conductor smaller conductors, and then convey it to storage batteries. I merely ask Dr. Moses' opinion as to what that might lead to if it were practicable to do that.

Dr. Moses: I think that would be a very excellent method of storing energy during the night time—a very excellent way. All these different methods of application and of storage will be applied. What we want is a constant source of current. There is not a machine in the world that does not make use of the wonderful force of gravity in its operation, but we do not think of looking for the gravity, because it is acting all the time. We want a source of power, and that source of power must be on top. Now, you may do what you please with it—take off secondary currents—tertiary—four or five times; it is only a question of economy. Each transformation will cost you from one and a half to two per cent.

Now, there was a question that was asked that I think was very important too—what are the actual conditions under which this thing is working? I will tell you what I saw. I did not wish to go so much into detail about it because it occupies too much time. However, if you desire it, I will proceed. I saw a conductor in which a current was passing that was a mile and a half from the central station—three miles circuit—Mr. Morrison, this is an interesting fact—they ran the current all through the stores in Pittsburgh. They were selling incandescent light in Pittsburgh, the home of natural gas; just think of it! We talk here about running electric light in competition—with gas companies. Natural gas is worth there about—I was going to say—a penny a ton. It is unlimited—the amount of natural gas in that neighborhood—and there they were running incandescent lights.

Mr. Morrison: Yes, but, Doctor, if the thing which costs a penny a ton is going to kill you the moment you get within reach of it, you would buy something else at $10 an ounce in preference. The natural gas, as has been proved, is dangerous; you cannot see it; you cannot smell it. All right, you can smell it. (Referring to a whispered suggestion from Mr. Duncan). There is one of the elements of the danger removed. Mr. Duncan says you can smell it—or some of it, and that is the kind they have in Pittsburgh. If there are certain kinds of it that you can smell why probably they would be able to use that kind if they were going to illuminate a house. He says they do not use the other kind that you cannot smell. Then how in the mischief did they poison a lot of people a few weeks ago with the kind they cannot smell? That was in the newspapers. I say if this element of danger is so great in the use of natural gas, you have at once an explanation why people take incandescent lighting in preference to using that natural product which could be had for almost nothing. I have talked with a great many people from the gas region and they all unite in saying that it is a most dangerous thing to handle, and that in any event they do not believe up to the present time of writing that there is any possibility of using it for anything except for fuel. Of course there are lots of schemes on foot to carry this natural gas all over the country. These things come to me from various sources. But the man on the fence says let us see how you do it.

Dr. Moses: I should not perhaps have referred to the natural gas so much as to this fact: Pittsburgh is built on one of the most magnificent coal deposits of the country, or right near it, and the result is that coal is as cheap as anything can be. You can dig it right out of the hillside. Some of the factories have coal beds under them; so that coal costs little, and you can make your gas from it readily; and yet they are buying incandescent light in that place. Now, this is what I want to call attention to. In a place that was very advantageously selected, in a place somewhat analogous in its character to the ordinary towns found throughout the United States. South Pittsburgh I would look upon as being a rather poor locality. I did not see many fine stores. It is narrow, which is the worst condition for the distribution of power; high hills on one side and the river on the other. Now, along that they distribute their lines. It is the worst condition possible, it strikes me, for the distribution of incandescent light.

Mr. Morrison: In the same country where they make gas so cheap, for the very reasons you have given, they can use coal oil cheaper.

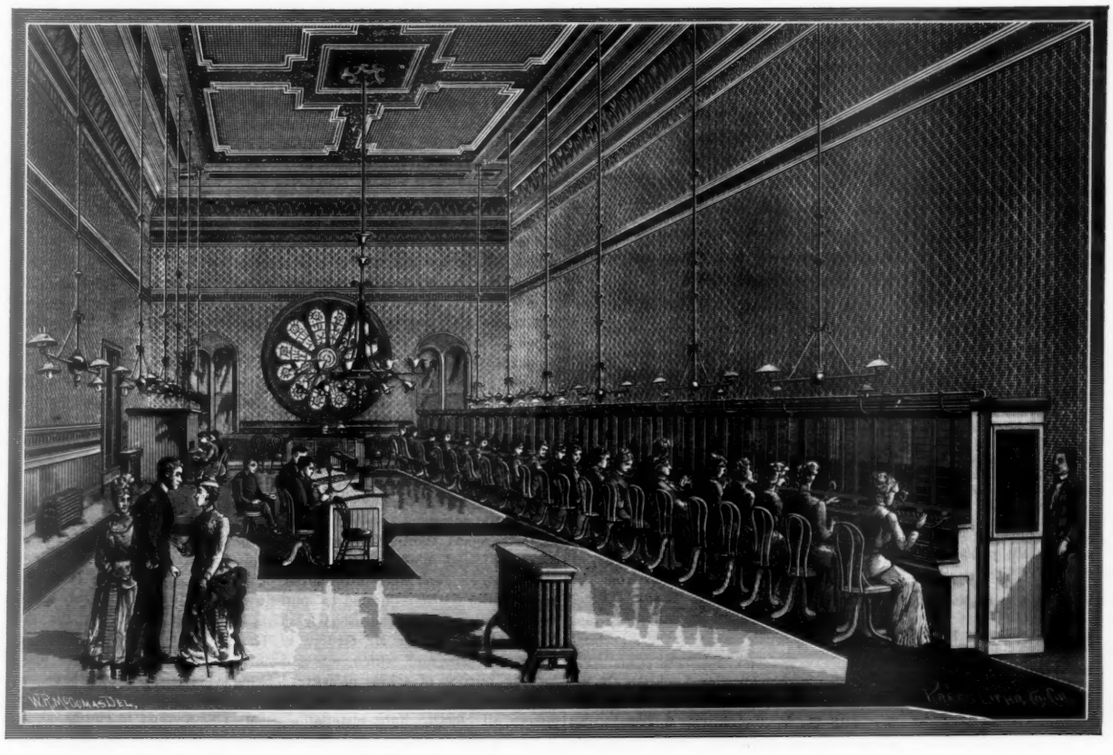
Dr. Moses: That is true; but still coal oil is very dangerous to handle.

Mr. Morrison: So is natural gas. This is the point I want to get at. Is the electric light taken in that locality because it is cheaper than gas, or is it taken because it is superior to gas? I assume the latter. In our city gas is sold at fifty cents a thousand feet, and has been for nearly two years, and yet we sell electric lights at a fair price. In this case, my idea of it is that people use the electric light because it is very much better, and because the air is pure about it, and for all these various sanitary and other reasons aside from the pocket.

Dr. Moses: I think a representative of a firm, whose headquarters are in New York, is here, and if I am not mistaken, that firm was interested in putting up the station in Pittsburgh, and will be able to give you some facts, I presume, in connection with the cost of that. I will tell you what I saw there, and that is all that I can say. I saw a battery of boilers working, self-regulating. I saw an engine working perfectly and self-regulated. I saw an exciter working perfectly, and almost self-regulating, a boy could turn it on or off, according to the indications of the meter. I saw an alternating current machine working perfectly. I saw a voltmeter working occasionally; and I saw only one man about the whole establishment. Now, Mr. Kerr, of New York, one of our members, I think—I am not sure of it—put in that station.

Mr. Morrison: Dr. Moses has made a magnificent presentation of a case of which no one knows anything except himself, and I perhaps will be accused again of a rude way of expressing myself, but I am trying to serve this Convention and I am trying to serve the men engaged in a line of business parallel with my own and out of which we expect to make our living. (Applause.) I

(*Continued on Page 9.*)



Interior View of the Handsome New Telephone Exchange, Cincinnati, Ohio—Improved Western Electric Multiple Switch Boards, Incandescent Light, Etc.—(See page 8.)

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NEW YORK, FEBRUARY 26, 1887.

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In the Illinois Legislature a third bill to regulate telephone companies was introduced on the 10th. This time by Senator Cantwell The bill limits the monthly rental for one instrument to $4, or two or more for $3 each. The same day the Committee on Corporations of the Indiana Legislature reported in favor of repealing the existing telephone law. Comments would be superfluous.

WE THANK YOU.

The REVIEW thinks it not unbecoming to express its thanks for the scores of congratulations and words of appreciation it has received, verbally and by mail, for the report covering the entire work of the Convention which it published last week. Our readers were not compelled to wait until this issue to learn what was done, but within a few hours after the adjournment in Philadelphia the REVIEW was issued in New York, containing a complete and thorough report of every action of the Convention; and although to accomplish this compelled the delay of one day in mailing, we think our readers did not complain when they saw the instructive and entertaining feast prepared for them, and which they received while it was new and fresh, and, consequently, much more valuable and interesting. It was not an easy matter to handle the mass of matter and present it so acceptably, but the young men of the REVIEW staff were equal to it, and the excellent work done by Mr. Ryan, our stenographer, was a great aid to success. To many friends in the Convention, who so kindly assisted, we take this means of expressing our sincere thanks.

A CONVENTION TRINITY.

The number three was by people in former times considered a sacred number, intimately associated with, because the square root of that higher mysterious digit 9.

In the Electric Light Association meeting of last week there were three prominent features to which more attention was given, and more intelligent discussion indulged in than in any others. These were improvement in methods of insulating—which means protection; motors—which means progression; distribution—which is the equivalent of economy. Protection, Progress, Economy—a glorious trinity.

Electric light men will be privileged, at the August meeting, to drink deep from the fountain of knowledge at Boston. Likewise taste the succulent bean in all its perfect glory.

The Cowles Electric Co., Lockport, N.Y., it seems are in interference in the Patent Office with C. A. Faure, who is prosecuting his applications vigorously, based on patents issued in Europe as far back as 1883.

Two very able electricians from Europe, Mr. Eugene Martin, General Manager of the Paris Electric Light Co., 250 Rue Lecourbe and Friederich Ross, Electrical Engineer, 111 Baumgasse 5, Vienna, are looking into the progress being made in this country in electric lighting and electric railways.

There have been a number of rumors of late concerning the failing health of T. A. Edison. He has been a sufferer from a severe attack of pleurisy, but is now improving quite rapidly at his winter home at Fort Meyers, Florida.

A feature of the convention of the electric light people at Philadelphia was the considerate courtesy of General Manager E. J. Hall, of the American Telephone and Telegraph Company, who placed at the free disposal of all the delegates a cabinet set of improved long-distance telephones. All conversations held by the numerous electric light people present were free, and those using the telephone to talk to New York City, Brooklyn, etc., were not only pleased, but greatly astonished at the satisfactory result. The long-distance instruments were placed in the headquarters of the ELECTRICAL REVIEW, and were a constant source of interest and edification to the delegates in attendance on the Convention.

THE CLUB MEETING.

The Electric Club was fortunate in its selection of Mr. Stephen D. Field as reader at the meeting on the 17th, and that gentleman was extremely felicitous in the selection of subject, coming as it did so immediately after the discussions in the Convention on the same subject, that of "Electric Motors." The meeting was a magnificent success, about eighty persons participating in the dinner.

THE WORK OF THE CONVENTION.

Notwithstanding the rapid work which follows as a natural result with that admirable presiding officer, Mr. J. F. Morrison, in the chair, no important detail was neglected. From the first moment the work of the Convention moved on smoothly and comprehensively. The opening was auspicious. The entertaining addresses convening and welcoming the Convention were followed by an exhaustive report from Mr. Garratt, chairman of the Committee on "Wire Gauges," which, after full discussion, was referred to a committee to tabulate and report, the new committee comprising the old, (Messrs. Garratt, Slattery and Stanley), with the names of Messrs. Moses, Weeks, Keilholtz and Eustis added. In appointing this committee the President complimented the former committee, saying that "if the new members do half as much as the old ones have done, we shall have a most excellent report at the next meeting." The first session concluded with the reading of Mr. Haskins' paper, which made a strong plea "For High Insulation," and which was discussed later at length, and resulted in the appointment of a committee to determine what qualities are essential to good insulation, and in what degree different insulations that might be submitted possessed the necessary virtues, and to report at the next Convention. The committee, which consists of Messrs. Houston, Marks, Hering, Garver and Robinson, will soon, no doubt, be the recipient of samples of wire insulation from the various manufacturers, tests of which will be made in Philadelphia. The powers of this committee were afterwards, on resolution, extended to treat broadly the questions involved, and embody in their report thorough treatment of the problems found in the setting of dynamos, converters, etc., and allied information. This committee was also requested to confer with the committee from the Electric Club of New York, of which Mr. George W. Hebard is chairman, and which was appointed for the purpose of taking measures looking towards arranging a set of uniform rules to govern all electric light installations. Mr. Weeks' paper, entitled "Popular Prejudice Against Electric Light Wires," deserves a most careful reading and consideration, and was discussed at much length Tuesday afternoon. Mr. Arthur Steuart's paper on "Patent Office Reform," as well as Examiner Kintner's remarks (both of which appear in full in this issue), were well received and to the point, and will start a movement that it is to be hoped will improve the present facilities and work of the Patent Office, particularly the electrical department. A committee on Patent Legislation, consisting of Messrs. Steuart, Kerr, Ridlon, Sprague and Morrison, was appointed to formulate a plan for presentation of this matter to Congress, the committee to report at the next Convention. "Belting in Connection with Transmission of Power," by Mr. Shay, of Chicago, was a practical paper, and was followed by papers and discussion on motors by Messrs. Baxter, Edgerton, Morrison, McDonald, Upton, Kerr, Garratt, De Camp, Pope and others.

The two leading features which followed, and can be mentioned in this brief review, were the addresses of Mr. F. J. Sprague, on "Electric Motors," and of Dr. Otto Moses, on "Secondary Generators." The long and animated discussion which followed each effort showed the intense interest taken by the electric lighting fraternity in these matters of progress. Both addresses appear in full this week.

The election of two visitors, Messrs. Fujioka and Yashima, of Japan, honorary members, preceded the annual election of officers, which resulted in again placing at the helm of the National Electric Light Association the skillful hand of Mr. Morrison, with Vice Presidents Weeks and De Camp as valuable aids. An exceptionally strong man, Mr. F. A. Gilbert, President of the Boston Electric Light Company, was selected for chairman of the Executive Committee, and he is backed by an experienced and hard-working committee, which comprises not only several of the able and tried pioneers in the work of the Convention, but it was reinforced by new blood, always a pronounced factor in the progress of any movement.

The Philadelphia Convention was a great success, and the outlook is most propitious for the Boston meeting.

BOOK REVIEW.

"Lives of the Electricians, Professors Tyndall, Wheatstone and Morse." First Series. William T. Jeans.

While for the scientist there are books and books, heavy with abstruse propositions and provings, the ordinary searcher after something in the line of electrical knowledge is too often fed upon the husk and chaff of this beautiful science. Clap-trap, catch-penny publications, dazzling with cuts and redolent with the perfume of self-praise and the taint of advertising, are foisted upon the public as storehouses of information. He who reads this work, which tells familiarly and pleasantly of Tyndall's simple and beautiful methods, of Wheatstone's earnest, thorough work, from the boy music teacher to the scientist and inventor—we know him—or the American portrait painter whose name stands enrolled for all time at the side of the latter—the brother pillars of electrical telegraphy—will find here a bright spot in the electrical field where lies upon one side the juiceless verdure of scientific formula, and upon the other the putridity of cheap, misleading electrical shoddy. The work may be had of Van Nostrand, 23 Murray and 27 Warren, New York.

"The Elements of Chemistry; a Text-Book for Beginners. American Science Series. Elementary Course." Ira Remsen, Prof. of Chemistry Johns Hopkins University. New York: H. Holt & Co. 1887.

This book is merely an abridgment of the Briefer Course by the same author. The style is clear. The illustrations might be better. The author's specialty is organic chemistry, and, perhaps, too much stress is laid on the carbon compounds. The inductive method is employed to a reasonable extent. From p. 129 a reader would receive the impression that hydrogen is obtained by the action of nitric acid on zinc, and the steps in the making of sulphuric acid are not as simple and easily understood as we might expect in an elementary text-book.

"The Pump Catechism," etc., by Robert Grimshaw, M. E. Practical Publishing Company, 7 Dey street, New York.

There has been no source from which information concerning the construction and management of the various styles of pumps could be obtained except from the meager details, often too technical, given in makers' catalogues. The book begins with questions and answers relating to the differences between different classes of pumps and the merits of each class. The general principles of design, construction, erection, connection and care are next described. Then follow description of the better class of pumps with simple yet exact instructions for setting up, adjusting and running. Convenient tables and rules are given at the end, sufficient for the ready solution of any problem relating to the subject. So numerous are the pumps in use at the present day, and so far from the place of manufacture are they sent, that a competent engineer is often called on to set up or adjust a pump he has never seen before. With the aid of this excellent hand-book an engineer can intelligently operate and adjust any steam pump. The book deserves a wide circulation.

THE ATTENDANTS.

Alphabetical List of the Companies Represented at the Electric Light Convention.

There appeared in the REVIEW last week a nearly complete list of names of all the attendants at the Electric Light Convention in Philadelphia, Feb. 15 to 17. It contained the names recorded in the REVIEW's register up to noon Thursday. To give our readers an idea of the companies represented and who the delegates were, the following alphabetical list is published, giving the address in full in each case :

Armington & Sims Engine Company, Providence, R. I.—Gardiner Sims, Providence; W. J. Kerr, Philadelphia.

Ansonia Brass & Copper Company, 19 and 21 Cliff street, New York.—Frank G. Stone.

American Electrical Works, Providence, R. I.—Eugene F. Phillips, Providence; Harry Hall, New York.

Allegheny County Electric Light Company, Pittsburgh, Pa.—S. A. Duncan.

American Telephone & Telegraph Company, 15 Cortlandt street, New York.—Angus S. Hibbard, New York; H. A. Pitcher, 55 South 3d street, Philadelphia.

Attleboro Schuyler Electric Light Company, Attleboro, Mass.—H. M. Daggett, Jr.

American Electric Lighting Company, Springfield, Ill.—A. L. Ide.

Bernstein Electric Company, 54 Equitable Building, Boston—H. B. Cram.

Brush Electric Company, (Parent), Cleveland, Ohio.—J. Potter, C. C. Curtis, Cleveland; Edward W. Tisdale, Philadelphia.

Brush-Swan Electric Company of New England, (Parent), 36 Union Square, New York.—J. B. Powell, New York; Frank Ridlon, Boston.

Bridgeport Brass Company, Bridgeport, Conn.—Fred. A. Mason.

Bridgeport Electric Light Company, Bridgeport, Conn.—H. D. Stanley.

Boulton Carbon Company, Cleveland, Ohio.—F. E. Pettingill.

Boston Electric Light Company, 209 Washington street, Boston.—F. A. Gilbert, Fred. Swift, Edward S. Sears, Frank Ridlon.

Benedict & Burnham, Waterbury, Conn.—D. L. Hungerford.

Brush Electric Company, 2011 Johnson street, Philadelphia.—Thos. Dolan, A. J. DeCamp, Myron Law, John Lober Welsh, R. H. C. Hill, Henry Lewis, Jr., A. H. Manwaring.

Buffalo Electric Light Company, Buffalo, N. Y.—John C. Weber.

Brush Electric Light & Power Company, La Crosse, Wis.—G. R. Montague.

Ball Electric Light Company, (Parent), New York.—H. W. Spang, Reading, Pa.; W. F. Kitsell, New York.

Ball Engine Company, Erie, Pa.—F. H. Ball.

Baxter Motor Company, Baltimore.—J. F. Morrison, Benson M. Greene, Pierre O. Keilholtz, W. Baxter, Jr., T. McCoubray, W. M. McDermott.

Brush Electric Light Company, Baltimore.—J. F. Morrison, D. E. Evans.

Brush Electric Light & Power Company, Savannah, Ga.—T. P. Keck.

Baker & Company Platinum Works, Newark, N. J.—Cyrus O. Baker, Jr.

Bishop Gutta-Percha Works, 422 East 25th street, New York.—H. A. Reed.

Brush Electric Light Company, Binghamton, N. Y.—John Anderson.

B. & O. Telegraph Company, Baltimore.—Chas. Selden.

Brush Electric Company, Cincinnati, Ohio.—S. H. Weissleder.

Ball Illuminating Company, New York.—W. F. Kitsell.

Chemical Electric Light and Power Company, Boston.—A. V. Garratt.

Cleveland Carbon Company, Cleveland, Ohio.—J. B. Crouse.

C. and C. Motor Company, 2 Wall street, New York.—S. S. Wheeler, H. L. Lufkin, C. W. Gould.

Callender Insulating Company, New York. W. M. Callender.

Cleverly Electrical Works, 1018 Chestnut street, Philadelphia.—Col. H. A. Cleverly.

Consolidated Electric Light Company, Portland, Me.—F. A. Sawyer.

Citizens Electric Light Company (Thomson-Houston), Brooklyn, N. Y.—E. F. Peck.

Day's Kerite Company, 16 Dey street, New York.—Clark B. Hotchkiss and Ralph W. Pope.

Electrical Accumulator Company, 44 Broadway, New York.—Chas. R. Truex.

ELECTRICAL REVIEW, New York.—George Worthington, Charles W. Price, C. C. Haskins (Chicago), R. W. Ryan.

Electrician and Electrical Engineer.—Geo. M. Phelps, Jr., R. W. Pope.

Electrical World.—Joseph Wetzler, C. E. Stump, T. C. Martin.

Electricians and Electrical Engineers and individual attendants not otherwise connected.—Dr. Otto Moses, New York; Prof. W. D. Marks, Philadelphia; Jesse Smith, Detroit; Arthur Steuart, Baltimore; Carl Hering, Philadelphia; J. S. Walters, New York; L. Porsh, Newark; C. A. G. Riege, Philadelphia; H. C. Townsend, New York; C. R. Deacon, Baltimore *News*; C. J. Kintner, Examiner Electrical Patents, Washington, D. C.; H. W. Pope, New York.

Electrical Supply Company, 17 Dey street, New York.—H. P. Hungerford, J. F. Kelley.

Easton (Md.) Electric Light Company.—Chas. T. Wrightson, James H. Covington, P. S. Reed.

Electric Construction and Supply Company, New York.—F. E. Kinsman.

Edgerton Motor Company, 13th and Market streets, Philadelphia.—N. H. Edgerton, H. B. Sharps, and James Mathews.

Eastern Electric Cable Company, Boston.—H. H. Eustis.

Falls Rivet Company (Friction Clutch), Cuyahoga Falls, Ohio.—A. L. Boyden, 115 Liberty street, New York.

Fire Insurance Patrol, Philadelphia.—Inspector McDevitt.

Fitchburgh Engine Company, Fitchburg, Mass.—Prof. Fosdick.

Fort Wayne Jenney Electric Company (Parent), Fort Wayne, Ind.—R. T. McDonald.

Fuller & Holtzer, Boston—Chas. W. Holtzer.

E. P. Gleason Manufacturing Company, 181 to 189 Mercer street, New York.—E. F. Gennert.

Greeley & Co., 5 and 7 Dey street, New York.—David Chalmers.

Holmes, Booth and Haydens, 25 Park Place, New York.—J. L Barclay.

Ide Engine Company, Springfield, Ill.—A. L. Ide.

Jamestown Electric Light Company, Jamestown, N. Y.—T. H. Smith.

Japan (Tokio)—Chisuke Fujioka, M. E., S. Yashima.

Jarvis Engineering Company, of Boston.—A. F. Upton, Boston; H. A. Glasier, Chicago; Edmund Mather, Harrisburg.

Johns Hopkins University, Baltimore.—Dr. Duncan.

Jenney Electric Light Company, Peoria, Ill.—J. P. Smith.

Kansas City Electric Light Company, Kansas City, Mo.—E. R Weeks.

Little-McDonald Cut Out, Troy, N. Y.—J. A. Powers, Norman McCarty.

McIntire & Co., Newark, N. J.—C. McIntire.

Millville Electric Light Company, Millville, N. J.—Stephen Holbrooke.

Munson & Co., 240 Randolph street, Chicago.—J. H. Shay.

McKeesport Electric Light Company, McKeesport, Pa.—Zack Latshaw.

Mather Electric Company, of Hartford, Conn.—Jno. W. Beane, 145 Broadway, New York; Jos. R. Simpson, Philadelphia.

Modern Light and Heat, Boston.—W. F. Brewster.

National Feed Water Heater, New Haven, Conn.—S. J. Fox.

National Carbon Company, Cleveland, Ohio. W. H. Laurence, W.C. Hayes, C. D.Smith.

New Haven and Newport Electric Light Companies,—James English, New Haven; F. A. Gilbert, Boston.

Niagara Falls Electric Light Company, Niagara Falls, N. Y.—Benj. Rhodes.

Northern Electric Light Company, 543 Diamond street, Philadelphia.—Geo. W. Boyer, W. C. Bryant.

Noye (Jno. T.) Manufacturing Company (Rice Automatic Cut-off Engine) Buffalo, N. Y.—F. B. Rice.

New York and New Jersey Telephone Company, Brooklyn, N. Y.—W. D. Sargent.

New England Glass Works, Boston, Mass.—S. O. Richardson, Jr.

Novelty Electric Company, Philadelphia.—Chas. S. Trump, Philadelphia; J. Chester Wilson, Altoona, Pa.

New England Insurance Exchange, Boston.—S. E. Barton, Chairman Electric Light Committee.

New England Butt Company, Providence, R. I.—H. N. Fenner.

Okonite Company, 13 Park Row, New York.—Willard L. Candee, Geo. T. Manson.

Paterson Electric Light Company, Paterson, N. J.—Jno. F. Noonan.

Partz Battery Company, 1723 Chestnut street, Philadelphia.—H. C. Frempt, A. Partz.

Pittsburgh Carbon Company, Pittsburgh, Pa.—Geo. F. Porter.

Philadelphia Exhaust Ventilator Company, Philadelphia.—Chas. S. Onderbook.

Roebling & Sons, New York.—F. A. Angell, Newark.

Royce & Marean, Washington, D. C.—Fred. W. Royce.

Sun Electric Company (Parent), Woburn, Mass.—Fred. Swift, M. M. M. Slattery.

Sprague Electric Motor and Manufacturing Company (Parent), 16 and 18 Broad street, New York.—F. J. Sprague, New York; H. McL. Harding, Boston.

Schuyler Electric Light Company (Parent), Hartford, Conn.—H M. Linnell, J. A. Dalzell, C. Griffith Young, Hartford; Stephen Holbrooke, H. S. Foster, Philadelphia.

Schaefer Electric Manufacturing Company, 2 Water street, Boston—L Schlegelmilch.

Standard Underground Cable Company, Pittsburgh, Pa.—Geo. L. Wiley, 128 Pearl street, New York.

Southwark Engine Company, Philadelphia, —J. A. Pentz.

Shultz Belting Company, St. Louis, Mo.—J. A. J. Shultz.

Simplex Electric Company, 328 Washington street, Boston—A. F. Mason.

Solar Carbon Company, Pittsburgh.—S. B. Richards, 55 South Third street, Philadelphia.

Southern Electric Company, Baltimore.—J. F. Morrison, T. Howard Tuxworth.

Smith (H. B.) Machine Company.—W. J. Kerr, 925 Market street, Philadelphia.

Silvey Electric Light and Motor Company, Cincinnati.—W. L. Silvey.

Sawyer-Man Electric Company (Parent), 32 Nassau street, New York—H. C. Davis.

Suburban Light and Power Company—Chas. W. Holtzer.

Troy Electric Light Company, Troy, N. Y.—J. A. Powers.

Thomson-Houston Electric Company (Parent Branch), Philadelphia.—E. D. Mullin, Harry Horne, 110 Noble street, Philadelphia.

Thomson-Houston Electric Company, Poughkeepsie, N. Y.—John N. Candee.

Thomson-Houston Electric Company, Springfield, Mass.—Charles A. Nichols, J. W. Hyde.

Thomson-Houston Electric Company, Woburn, Mass.—W. R. Kimball.

Thomson-Houston Electric Company.—A. F. Mason, 328 Washington street, Boston, Mass.

Thomson-Houston Electric Co. (Parent)—A. G. McCleur, 178 Devonshire street, Boston.

Taunton Electric Light Company, Taunton, Mass.—D. L. Mitchell.

United States Electric Lighting Company (Parent), 59 and 61 Liberty street, N. Y.—Henry Hine, Wm. Hine.

United States Illuminating Company, 59 and 61 Liberty street, New York.—Eugene T. Lynch, Jr.

Western Electric Company, New York and Chicago.—Col. George L. Beetle, Frank Harrington, Frank Stewart.

Westinghouse, Church, Kerr & Co., 17 Cortlandt street, N. Y.—W. C. Kerr.

Waterhouse Electric Company, Philadelphia Office, 134 South Ninth street.—D. F. Van Dyke.

Williamsport Electric Light Company, Williamsport, Pa.—B. C. Wilkinson.

Washburn & Moen, New York.—R. K. Dana.

Additional Convention Notes.

New Haven and Bridgeport delegates had no difficulty in talking to their home offices over the long distance telephone.

The emphatic "skip that" of the presiding officer, prevented on two occasions the mortifying of certain more or less advertising schemes on the part of authors of papers.

The efforts of Mr. Geo. F. Porter, and the influence he had with the Pullman Company, are what secured the special car to New York; travel being so heavy the company at first refused.

Chas. Selden, C. C. Haskins and Wm. Hine proved to be the entertaining story-tellers of the Convention. Col. Gardiner Sims, could he have remained, would have increased the list.

The small rolls of samples of okonite tape which were given to delegates were highly prized, and are by this time widely distributed over the country. They were pocketed very generally by all visitors to the elegant headquarters of the Okonite Company.

Mr. F. J. Sprague made a most excellent impression, and bore the severe ordeal of an exacting running debate in a manner that proved him thoroughly master of his subject. Expressions of appreciation of his able effort were heard afterwards from scores of listeners.

The pocket and note books provided by the Western Electric Company went off like hot cakes. It was a happy thought to manufacture these very convenient receptacles and so generously give them out. These pocket books will be in great demand until the electrical fraternity is all supplied.

The proprietors of the Hotel Lafayette, at Philadelphia, seemed to have no difficulty in properly and thoroughly supplying every need of the Convention. There is an intuition necessary to hotel keeping, if one would do it successfully, and Messrs. Maltby & Baker proved themselves masters of the art.

A telegram from F. A. Gilbert, who was called suddenly home Wednesday on account of severe illness of his wife, was received by a delegate, in which Mr. Gilbert strongly urged the re-election of President Morrison, and on behalf of the Boston Electric Light Company, invited the Association to hold its next meeting in Boston. The only question concerning Mr. Morrison's re-election was whether he could be persuaded to serve, and when his consent was finally secured, there was not an opposing voice, and the thoughtful and hearty invitation of Mr. Gilbert was as unanimously accepted.

Mrs. J. F. Morrison and the Misses Fulton, wife and nieces of the President, were Philadelphia visitors, and honored the various exhibition parlors with calls during the Convention. They were the recipient of a beautiful basket of flowers on Tuesday. A number of other delegates brought their wives, among these being Mr. and Mrs. Fenner, of Providence, Mr. and Mrs. C. Nichols, of Springfield, Mr. and Mrs. Curtis, of Cleveland, and Mr. and Mrs. Buckley, of Chicago, and it was reported that Mr. and Mrs. Gardiner Sims, of Providence, were present, but no announcement of Mr. Sims' marriage having yet reached this office, we are inclined to doubt.

In connection with the interesting exhibit of the Sun Company, of Woburn, Mass, was a very ingenious cut-out, the work of P. Fahay, superintendent of the Boston Electric Light Company. This invention is particularly noted for its lack of possibility of carrying an arc. Its mechanism is such as to make it impossible for it to stop at any intermediate point, whereby the line might be opened. There was also exhibited a clock, invented by Chas. H. Stoll, of Lexington, Ky., which is used as a register to determine the length of time the incandescent lights in multiple series were cut in and out of arc circuits, making, it is claimed, a thoroughly practical meter.

Telephonic News

*** A big sleet storm one week ago last Friday did considerable damage to the Kansas City telephone exchange.

*** A recent sleet storm in Brooklyn and New York caused considerable damage. A number of poles were broken down and a great many wires also. The damage done in Brooklyn was estimated at about $5,000, to say nothing of the annoyance to subscribers.

*** Butte, Mon., is now connected with Helena and Missoula by a special telegraph wire from the Northern Pacific, and Mr. H. E. Jenison, Superintendent of the Western Union, is arranging for two additional wires into Butte.

*** The Bell Telephone Company, of St. Louis, Missouri, has elected the following-named directors for the ensuing year: E. A. Hitchcock, Charles C. Maffitt, James Campbell, Edwards Whitaker, John R. Lionberger, Geo. F. Durant, Wm. H. Forbes, Theo. N. Vail, Geo. L. Phillips, John E. Hudson and W. A. Hargadine.

*** W. J. Donshea, formerly general superintendent of the Campanhia Uniao Telephonica Do Brazil, has returned to New York from Brazil, and will in future make this his home. The telephone business of Brazil is largely controlled by his company, some 2,000 instruments being in use, 1,300 being in use in the city of Rio Janerio.

*** During a storm at Rochester recently the poles bearing the Western Union wires across one of the bridges were blown down, carrying away a part of the structure and hurling four foot passengers into the Genesee River. It is claimed that the poles were placed upon the bridge against the protest of the city authorities, and a suit for damages is proposed.

***Meeting the chief of the fire department of one of the fashionable suburban cities, the question was asked if there was any difficulty in obtaining permission to place poles.

"We had a case not long ago. A petition for a fire alarm box for a certain district was granted, but when we came to set poles and locate the box, so much opposition was aroused that it was never placed."

*** Mr. W. J. Armstrong, formerly cashier of the Western Electric Company, New York, has accepted a responsible position with the Chicago house of this great electrical company, where he will undoubtedly win fresh honors in electrical work. Mr. Mills H. Landon, formerly of the Chicago house, succeeds Mr. Armstrong as cashier at New York.

***Muecci's telephone has again come to the surface in the grand telephonic swim—there always are bubbles and straws and bottomless barrels in a whirlpool. The aged Italian was in Chicago a few days since, and was, of course, interviewed by a reporter who had just so much space to fill, and Antonio, through an interpreter, helped to do the padding. To boil down this "cauld kail het agin," we learn that a theory that disease could be cured by electricity induced him to put up a wire and battery "which were connected so as to form a complete circuit." Each [?] wire was connected with a copper plate which the Italian caused the man [on whom he experimented] to put in his mouth. Both men [he must have been twins] were in different rooms, and the shock to one caused him to exclaim when he put the copper plate into his mouth. Muecci at the other end of the line had the copper plate between the teeth, and heard the sound, the communication being through the medium of the teeth to the auditory nerve.

From this description, copied verbatim, save that portion in brackets, if any ordinary wire man can run the circuit there is a nice situation open for him in a well lighted and thriving straddle town on the banks of Fox river, as general electrician for the city.

The Porter Electric Messenger.

This system is in use in the Hotel Dam, New York, and is giving excellent satisfaction, and will, no doubt, be largely adopted by the leading hotels of the country.

Two views of this ingenious call appear on page nine. It is arranged to have a box in each room of the hotel, which any guest can operate. This box simply acts as a gauge, there being no electrical contacts to get out of adjustment, and no gear wheels or escapements to keep in repair. The box consists of one wheel, magnet, and a hardened steel verge over one-eighth of an inch thick, all covered by a heavy brass case provided with a glass front to protect hand and dial. By means of the small knob projecting through the glass a guest moves the pointer either right or left. It would not injure it in the least if he should turn it around a number of times either way. Whatever message the pointer is left over will register at the office at once. The pointer will not stop between any of the messages, and there may be a hundred or more messages on the dial; from 20 to 25 is all that most of the hotels require. The boxes are as easily applied and connected up as the ordinary push buttons, and are manufactured in three different designs of metal cases. They are but 5 inches in diameter, 2 inches thick. At stations where "wants" are not required such as front doors, private dining rooms, laundries, parlors, halls, etc., a neatly designed polished metal push button is placed, which will call the hall boy. All the boxes and push buttons are said to be absolutely non-interfering.

The office register shown in figure 1 works automatically. The cut shows a dial 20 inches in diameter and is for operating three hundred rooms. The same size and figures will register with no interference whatever from one hundred to one thousand rooms. It will be seen from the illustration that 232 has called for "ice water." Should room 132 send a call the first flap would fall—reading 132; should room 32 send a call neither flap would drop, the hand simply pointing to 32.

With the combination of hand and flaps there can be an unlimited number of boxes operated. The cases are made in a number of styles of any kind of wood required. The movement is very simple and reliable, consisting of three large wheels mounted upon a hardened steel shaft in combination with but two magnets and drum for operating "want" dial, thus doing away with hundreds of magnets packed close together, constantly getting out of order. The interior of case has an improved method of numbering, the wire connections keeping them separate, thereby making it an easy matter to test any of the circuits. The company manufacture a smaller size case for from 10 to 75 rooms, the register being entirely automatic, not requiring the clerk's time to operate it. The clerk's attention is not called until the call is registered, when the vibrator bell announces it. A slight move of the lever stops the vibrator and the instrument is ready for another call. In case a number of boxes were set at the same time the calls would register ten calls per minute, one after the other, with no interference. The register is also provided with an attachment for warning the clerk of any persons meddling or playing with any of the boxes in rooms. In applying the Porter system in modern hotels where the common annunciator has been working it requires no extra wiring, simply attaching the boxes in place of old push buttons in each room and connecting wires same as were in old buttons. These connect the automatic register to the same wires to which the old annunciator were attached, and by applying about the same battery power as used on the old system the Porter system is ready for work. In applying this system in new hotels the company require but one wire running from the boxes to register in connection with a battery wire.

By this system the guest is enabled to telegraph immediately to the office for anything he requires, and he also knows his message has been received. The clerk knows just where his boys have gone and what for, saves ice pitchers, carpets, extra hall boys, and enables the proprietor to have a perfect system to his hotel. A guest on entering a room very readily understands how to operate the box. If he wants a waiter he moves the pointer over the word "waiter," and there leaves it, and then the pointer moves to the star, signifying that his message is known at office. The New Haven Clock Company, 16 and 18 Park Place, are the manufacturers.

A New Chicago Electrical House.

Mr. W. H. McKinlock, secretary of the Detroit Electrical Works, will on the first of March open an electrical house in Chicago for the purpose of manufacturing and dealing in electrical goods of all kinds, particular interest to be taken in the electric lighting field. He will have associated with him his brother, and an abundance of Chicago capital, and in this larger field will no doubt find full exercise for his ability and industry which were such important factors in building up to its present commanding position, the Detroit house.

Mr. Wm. A. Jackson, the present vice-president and treasurer, will take more active management of the Detroit house, which fact alone assures its continued success and advancement.

Chicago and the great West will find Mr. McKinlock a reliable and energetic and progressive young man worthy the esteem and confidence of all, and the REVIEW extends to him its most earnest well wishes for an abundant and well deserved success.

Our Belgium Letter.

BRUSSELS, BELGIUM,
January 29, 1887.

To the Editor of Electrical Review.

DEAR SIR:—For the past six months there has been nothing very interesting here in the electrical field. Several plants of electric light were installed in cafés and hotels at Brussels and Liege. The temporary building of the post-office is now well lighted by arc and incandescent lamps.

No new steps have been made in the lighting of the railway stations; however, it is expected that the stations *du Nord et du Midi*, the two most important in Brussels, will receive a large portion of their light by electricity in the course of this year.

The officers of the Palais de la Nation, Chambre des représentants et du Sénat, have rejected the electric light as an illuminant for the new palace lately reconstructed. The excuse is laid to the cost of the plant and maintenance. I am of the opinion that the device was not correctly established. No electrical company was consulted. Another question has been raised, namely, the lighting by electricity not only of the said palace, but of all the hotel buildings, and offices of the ministers. This project includes about 7,000 incandescent lamps, and it is now submitted to the examination of the engineers of the telegraph department.

Telephonic communication between Paris and Brussels was successfully carried on the last days of December, and the Ministers of Belgium and France interchanged compliments of new year by this long distance line. New experiments were made the 26th and 29th inst., and they could not be more successful. We expect the lines to be open to the public next week.

A special and very interesting exhibition of telephonic apparatus is now held at the Bourse by the Societé des Ingenieurs et Industriels. I will treat this subject in my next letter.

An exhibition of international character is in preparation to be opened at Brussels in 1888. This exhibition promises to include all kinds of industry, and a competition will be held for excellence and merit of invention and manufacture under this title: "Grand Commers International des Sciences et de l' Industrée." This project is received coldly, as it is objected to on the ground that this exhibition would come too near to the great international exhibition of 1889 at Paris, which is expected to be the greatest of the century.

Before closing my letter, I wish to call the attention of your readers to the means of conveyances of packages to Belgium. Commonly they are committed to the care of express companies, who ship *via* le Havre, France, with enormous cost. The best is to direct the goods by the Red Star line, that send every Saturday a steamer direct from New York to Antwerp, and *vice versa*. A.

The New Cincinnati Telephone Exchange.

There are not many general officers of telephone companies who have not experienced a change—not of heart—but of central office. Improvements have been so numerous, and the growth of exchanges in the cities have been such as to demand better and increased facilities. The inventing and bringing out of the multiple switchboard marked a new era in the telephone business. It enabled each operator to have the entire exchange at her command, doing away with all the annoyances of calling, sending messengers, etc. One of the most recent of the large exchanges which received the benefit of the latest improvements in the multiple system was that of Cincinnati. Capt. Geo. N. Stone, the presiding genius of the telephone situation in that neck o' woods, decided that his city should have telephone facilities second to none. The multiple system was put in, hard-drawn copper wire used for outside lines, and the entire wire system was reconstructed. To-day Cincinnati has a model telephone exchange, and the REVIEW takes pleasure in presenting a view of it to many interested readers. A full description of the work done in Cincinnati was published in these columns a short time ago, and it is only necessary now to state that the exchange is located in the Masonic Temple, is fitted up with taste and an eye to convenience, and is daily operating 2,300 wires to the great satisfaction of as many patrons. The material was all furnished by the Western Electric Company, of Chicago, including switchboards, copper wire, cables, and all that goes to make up a model and perfect telephone exchange.

Electrical Searches for Bullets.

When President Garfield was slowly dying at Elberon, and the attending surgeons were locating the fatal bullet in spots clear away from where, after death, it was discovered, an electrical apparatus was constructed by Prof. Graham Bell for the purpose of finding the bit of lead. The failure was ridiculed much to the chagrin of Bell and the doctors. The discovery has since been made that Garfield lay on a metallic mattress, which frustrated the electricity. Now, under the sanction of the New York Academy of Medicine, says the *Sun*, a machine has been constructed and tested. The machine consisted of a battery, coils, and other familiar telegraphic devices, but principally of a thin steel probe connected with the wires in a manner invented by Bell. The surface of the patient over an embedded bullet was cocained, so as to deprive it of feeling. Then the probe was thrust in. As the end of the steel came within six inches of the bullet, the surgeon, with his ear to a telephonic cup, heard a humming sound, which grew louder as the metal was approached. The flesh was jabbed a number of times, and the trial was regarded as a success. Later a war veteran submitted to a search for a bullet that had entered his chest and remained somewhere in him for twenty years. The needle hummed its way to the lead's hiding place and it was removed. Dr. John H. Girdner, who operated the instrument, said that its use would have saved Garfield's life in all probability.

Quantity Not Considered.

A widow in a town in the interior of this State made her appearance at the office of the gas company the other day and asked if it was true that electric lights were to supersede gas in all the public lamps.

When answered in the affirmative, she continued:

"I own gas stock, and I want to know if this move won't reduce dividends?"

"Most assuredly not, madam," replied the secretary.

"But it will be so much less gas consumed?"

"Exactly; but what has the quantity of gas consumed to do with the gas bill?"

She went away without answering the query, but perfectly satisfied.—*Wall Street News.*

(Papers and Discussions at the Electric Light Convention.—Continued from page 5.)

am only going to say two or three words and that brings you right up to the point—the oldest station in Pittsburgh, a description of which has been given you by Dr. Moses, is two months and a little over old. The other station, the one from which all these stores are illuminated, has been in service a little over two weeks. That ends my statement of the case. (Applause.)

MR. KERR: The turn the discussion has taken allows me to make a statement in regard to the commercial aspect of the case, which is what the President is referring to, without having connected with my remarks the taint of advertisement. I have had a good deal to do, and those with whom I am associated have had a great deal more to do with the development of new things. In fact, we have never done anything but develop something new. But it is an old story with us to have come up the jumble which always follows upon the first steps of something new. There is always a great deal of misunderstanding, a great deal of doubt and a great deal of what we see right here—a most commendable desire for information, which information cannot always be answered in a breath. For instance, Mr. Morrison has asked Dr. Moses some questions which naturally would be very hard for Dr. Moses to answer. He, as a scientific gentleman, has gone to examine some things and has formed some very conclusive impressions, as one can see from his description. It is not to be supposed that a gentleman going there to investigate the scientific aspect of a development, such as this secondary generation through induction, would formulate in his mind something with which to answer questions as to durability and what are the results in a certain town and all these commercial questions which arise. It can be said of this system that it is not a thing which is developed so that a man can say we guarantee this for twenty years or something of that kind. It is simply in that condition that all new things are. There have been various machines built, the system has been put in in various places, and some time must elapse to enable people to form their impressions. Without intending now to make any advertisement of the system, I will venture for the information of those who may desire, as Mr. Morrison does, to say this—that there are six places where it is operating and where lights are being rented, and some of those may be near where some of you live. There is one at South Side, Pittsburgh; there is one at Greensburgh, Pa.; at Carbondale, Pa., at Plainfield, N. J., at Buffalo, N. Y., at Torrington, Conn.—a small one there which will be in operation, I suppose, within two weeks. So that within the present spring any one living near those places can see it in operation. Now if any of you live near those places you can see some of those things and form conclusions of your own. Nobody can say when they start to build a certain apparatus that this thing is just so. One can look into it, however, and see what relation it bears to other things which are known to work successfully, and deductions can be made which cannot be proved in a day or a month. That is the condition that system is in at the present time. It is working; it is running successfully. A contrast can be made by visiting a station where that is in use and visiting a station where other things which it resembles or which it supersedes to a certain extent are in use. Take, for instance, an illustration right near us here. Suppose some one goes down and notices, as you did here last night, a station down in Sansom street—one of our stations, or go to Trenton where there are about 2,300 lights operated, and notice what the station apparatus is to operate a station on 200 volt machines, three wires and 100 volt lamps which is the system in use at Trenton. Now go to Philadelphia and notice what the station apparatus consists of and the nature of the attendance upon that station. There is a better demonstration than anybody can stand up on the floor and give. It is very difficult indeed when a thing is as new as this and has only been brought before the public within three or four months, to make specific statements as to which anybody would wish to be bound in respect to durability, consequently such questions cannot be answered at this early day, and all we can say to those who are interested is that at this place I have mentioned the apparatus is open for the fullest investigation; and especially if any one goes to Pittsburgh, there they can see three or four or ten times as much as they can see at any of the other stations, because there they can see their parts and details which are working in ways which can be manipulated before them. This is not an advertisement for the system, and a reply to every specific question cannot be made at the present time as to what the durability is or what the commercial aspect is. I think by the time this Association has a meeting in Pittsburgh things will be in such a condition as to enable you to see a great deal.

MR. MORRISON: Mr. Kerr has arrived at the point which I desired to reach. I wanted to do away with the impression that this was a problem which had been absolutely solved and proved by experience. I think Mr. Duncan, of Pittsburgh, will supplement that with some facts.

MR. CURTIS: I was in Pittsburgh about a month ago, and I investigated somewhat, in the short time I was there, this question. In consulting a gentleman there who stands as high as any man on this question, he told me that of his own positive knowledge six or seven armatures had been burned out in one machine inside of thirty days. I would like to ask Dr. Moses if he had any points in that direction.

FIG. 2.—CALLING DIAL FOR GUESTS' ROOM.

FIG. 1.—PORTER ELECTRIC MESSENGER OF NEW HAVEN CLOCK CO. (SEE PAGE 8.)

DR. MOSES: I looked everywhere that I was permitted to look. I was very glad to have an opportunity, in the enormous factories of the Westinghouse Company, to see all the details, and for that reason, perhaps, I should be guarded in what I say; because I know myself that in such large establishments there may be things going on not at all relating to this that might be spoken of. With regard to the armatures, I had the privilege of seeing them manufactured from the first point up to their completion, and every precaution was taken, and I have had some experience in making dynamo machines, so that I do not see why they should continue in certain grooves which they seem to have cut out, if these machines burn out so rapidly. If they burn out six a month I think I would swap horses crossing that stream. But they seem to manufacture them that way.

MR. DE CAMP: I want to put some queries which I think will get this down more to a practical point. Doubtless we have to go through the same troubles with that system, if it is one that is capable of being developed, as we did with all other systems. It appears to be an old thing recently found. That throws around it some suspicion. If this system of induction has been so long known, why has it not been more generally utilized? I will mention now some criticisms that I have heard made on this subject. In the first place I will refer to one of the minor objections that is made to it—the safety of the current. I presume that if we can utilize it we can control it. Now, what is the economy of it? This is not original with me, but arises from suggestions made by other people. This lighting from which we get our revenue is done by induction. How much loss is there in that induction? How much do we lose of the current that goes into that induction coil? Next, do we not have induction coils innumerable along our line, or in our conduits, or in whatever method we may carry our distributing wires, from which we can get no revenue? For instance, a gentleman said to me that close contact of these wires to an iron-fronted house would create induction and loss of current. I do not know anything about the facts of the current. I am simply asking that for information. That is all I will say at present.

MR. DUNCAN: Mr. Chairman, I just want in advance to take one exception to the statement that you made while on the floor, leaving the impression on the minds of those here that natural gas was a very dangerous thing to deal with. As it is one of our great industries in Pittsburgh, I want to go on record to the contrary. The chair wants to call me down (referring to a whispered suggestion of the President) on discussing natural gas after having brought it up himself. I just want to say this, that if you will take the records of the introduction of natural gas into the city of Pittsburgh from the day that the first furnace was lighted by natural gas to the present time, the number of accidents and the damage to property has been nothing as compared with those due to ordinary illuminating gas. Those are statistics which are easily obtainable and which I hope the gentlemen of the Convention will look up for their own satisfaction. The question was asked awhile ago in regard to why incandescent lights were used in Pittsburgh as against coal oil or as against cheap gas or as against natural gas. Natural gas cannot be used at the present time as an illuminant with any degree of satisfaction. There is a certain deposit which goes off from natural gas into a room which forms on the walls and the woodwork and makes it a very unpleasant thing to have in the house, and that is one reason why it has not been generally utilized, and the process, so far as experimented with, has not given entire satisfaction; so it has not been generally introduced and very little has been said of it among us as an illuminant.

Now, I believe the reason why incandescent light is used in preference to cheap gas is this: Hitherto we have always had a very dirty city, except in the last two years, when we have brightened up a little. We had heavy fogs, etc., and up to that time very poor gas. The consequence was that the gas companies were wonderfully stirred up, and we get a very excellent quality of illuminating gas at the present time from eighty cents to a dollar a thousand. They reduced it to eighty cents. Now, the people prefer the incandescent light for several reasons. In the first place it is easily handled. It can be placed in their stores and in their rooms, in such places as they desire to have a light. It can be controlled by the cut-offs and switches in such a way as to make it more accessible and less troublesome to them. In the next place, it is a cleaner article and causes them less trouble on that score. So that is the general statement of the reason it has been so generally introduced in that city. I may say that we are wired up for three thousand more incandescent lights at the present time than we can supply, for the simple reason that we have been reconstructing our station.

In regard to the alternating current system I have simply this to state. The Allegheny County Light Company is not operating at the present moment the alternating current system. The Pittsburgh Light Company, which is a company organized and operating in the south side of Pittsburgh, is operating the alternating current system. That light and that machinery have been in operation there for two weeks. They are running about 600 lights. They are distributing it over a mile and a quarter of territory in length, confined between the Monongahela river and the hills, which is a narrow strip of land, as anyone familiar with Pittsburgh knows, at that side of the river, there being only two streets between the river and the hillside. After you get up to 26th st. the land there opens out and you get a larger area of territory to cover; but the lighting is practically confined to the two main streets there, and the side streets between 8th street and 26th street. Now, this system has been in operation there for two weeks. It is hard to ask a man to stand on a platform before a convention and say, in two weeks' time, in regard to the economy of a system, in regard to whether one armature burned, or whether two thousand armatures burned out. It is not so long ago when dynamo machines were insulated with paper, and the bobbins were burned out. It is not a fair matter of discussion at the present time before this Convention. There is the Greensburgh plant. It has been operated for two months. I have been told by reliable people that there were some armatures burned out. I have been told by the engineer in charge of the station that one armature in one machine has run consecutively for over four weeks. I claim that any electric light apparatus that will run four weeks, can run for an indefinite period. So I do not think that that enters into this discussion at the present time. It is something new, and I do not think that any question of burning of armatures, or things of that kind, should militate against the proper discussion of the system here. You have all heard from the scientific gentlemen who have told you in regard to the possibilites of the system. I may say for myself that when

I first looked into it I did not think very favorably of it. But after several visits to Greensburgh, and looking over that plant there, and the operation of the South Side plant, where they turn on those 600 lights and everything runs on smoothly, the matter of the regulation of the station being as close as two and a half to three per cent, I commenced to think there is a great future for it, and I cannot see why there should not be. Now, I shall be very ready at any time, if you gentlemen want further information in regard to the economy of this system, to give you, when I have charge of it myself, all the information I can from the commercial standpoint where the dollars and cents come in. But at the present time the system has not been sufficiently developed to enable you to see what the relative difference is in dollars and cents.

MR. POWERS: I have just a word to say about this system of distribution. In the first place, if you have a certain current of high tension (we will presume we are working altogether with high tension current, whether alternating or direct) and convey that current a mile, you must pay so much loss for it. Now, there are common systems in use to-day, such as you perhaps are all using, by which you may take that current and produce incandescent light from it. The trouble is that there is a lack of flexibility. Now, if you put in converters using an alternating current and at the distance of a mile convert this current into a low tension current you gain your flexibility and you pay your loss of conversion for it. That is simply the difference between the two systems, as I see, that the loss must be precisely the same for the conveyance of the current—that you simply pay the cost of conversion for the flexibility of the system. Now, there is another question—the question of danger. In connection with alternating currents I have had some experience in the manufacture of small alternating current machines, and I know something about the effects of alternating currents on the human system, and I assure you that they are extremely unpleasant. I would rather take a shock from a thousand volts of direct current than from five hundred volts of alternating current. Now, the question that has occurred to me in this matter is this: Suppose that you introduce your system of distribution. You may have occur on your high tension line—on one of the lines, we will say the positive line, a ground. Suppose that a person within a building, standing on a radiator, or some other grounded connection, takes hold of the secondary connection or lampholder—something that will ground him at that point, is there not extreme danger of a current of that potential destroying the insulation? Is it not a temptation, in other words, to destroy the insulation and to produce fatal results there? That, it strikes me, is the most dangerous aspect of the affair. I think variation might be produced in the same way. I simply wanted to say that there was one thing particularly that we must get our minds clear on—alternating or direct, the cost or transmission of a given quantity of current to a given distance will be almost the same, if not precisely the same. There is no difference in that at all. The simple difference is that we get the flexibility in one system and we do not get it in the other, and we pay for it in our loss of conversion.

MR. SLATTERY: The unusually able and lucid manner with which our scientific friend, Dr. Moses——

THE PRESIDENT: Please step up on the platform.

MR. SLATTERY: Mr. President, if you will allow me to stay where I am, I will see that no harm comes to this particular part of the floor on which I am standing. I have a sore throat, I am sorry to say; I went to a scientific meeting last night and took away more gas than science. (Laughter.)

I was going to say that it was almost superfluous for me to make any remarks after our friend Dr. Moses had treated the subject. I almost regretted at the same time that the subject of secondary generation had almost acquired the tenuity of a gaseous condition after the many questions regarding the case that the subject finished up with. However, there is no question whatever about the importance of this subject, notwithstanding its gaseous tenuity, as both the natural gas and the inductorium subject are very kindred ones in the connection in which they were brought before us to-day.

There was another thing I regretted. I should have liked to hear very much from Dr. Moses what the efficiency was of the induction system that had received his close attention. We are all interested, of course, in understanding the value of the application of every new electrical system to dollars and cents, and the fact of leaving out that most important element of its commercial importance to us, its commercial application and utility was, I would almost say, an omission; but I have no doubt whatever that the Doctor will treat us upon some future occasion to remarks on that point that will no doubt edify us.

I beg to differ from Dr. Moses upon one point, and that is I think he created the impression—he certainly did in my mind—that no induction coil had been made previous to that made by Messrs. Gaulard & Gibbs that would be suitable for converting high tension into low tension. You are all of you, or most of you, familiar with Faraday's coil, which Dr. Moses referred to, and in that coil he used about No. 14 Brown & Sharpe's gauge (1' 20"), and I believe that the diameters of the primary and secondary wires were nearly identical in that coil, and also the number of turns upon the primary and secondary wires. Were such as that placed on a multiple arc circuit, or a series circuit, such as the Gaulard & Gibbs is represented as being, we could get a commercial result from it. That is to say, if we passed ten amperes through that primary coil of Faraday's, and No. 14 Brown & Sharpe's gauge has a perfectly safe carrying capacity of ten or twelve amperes, we should get commercial results in the secondary circuit; that is to say, we could operate incandescent lamps. If I am wrong in making that statement the Doctor will no doubt correct me.

Yet there is one point I did carry away last night from the scientific institution that we had the pleasure of attending, and I believe it created an unfavorable impression with many of the delegates who were present. A statement was made that the secondary generator disintegrated after being in action for a certain length of time. Now, most of our enthusiastic cranks have been quite eloquent in advancing this fact—that the converter itself is an indestructible thing—almost indestructible, in consequence of the fact that it will last an almost unlimited time. The statement he made was a correct one in that particular construction of converter where the iron is used upon the exterior instead of the interior. He informed you that in consequence of the great heating of the converter when in action the insulation of the copper wire was seriously hurt. The reason of that is simply because the heat is so confined, and if a copper wire was put upon the outside instead of the inside, no such disastrous results would ensue. That has been pretty conclusively proved. That coil which he showed you, it was stated, was used by Messrs. Westinghouse. I almost doubt that. But there are gentlemen here who can give us a clear statement upon that point. If they use such a converter as that they will experience the difficulties that that gentleman dwelt upon with some truth.

A great many statements have been recently made in the newspapers, in the electrical periodicals particularly, with regard to the efficiency of the induction systems now before the public. But as very frequent stenographic errors crept into those statements, it would be a very desirable thing to have some clear and emphatic statement on the part of those who are practically using the system as to its real commercial worth.

Mr. De Camp very sensibly brought forward an important feature that we should be glad to hear further concerning. We want to know what the return is from a converter with so much energy passed through it. It is a point that those who are more competent than I am, who are present, might give us some information concerning. I scarcely like at this stage of the business—I almost echo Mr. Kerr's sentiments—saying anything further concerning a matter that is at present in a very—not a crude condition—it is reduced to a practical basis, a basis that scientific men feel the most unbounded confidence in; but as there are a very few practical heads around us to-day who want very emphatic statements concerning the stage of perfection to which this system has arrived, it is almost to be regretted that this brilliant opportunity should have to go by without elaborating in the enthusiastic manner that one feels like doing, on a subject that is fraught with so much interest to us all. There can be no doubt at all, gentlemen, about this fact—that the transmission from high tension into low tension can be done efficiently. Both the newspapers and people practically applying the system have unbounded proofs of that.

I don't know that I have anything more to say upon that matter this morning. I notice that we have extended the time of discussion of this subject almost beyond the limit, although it is in such a condition as to give us very little latitude to speak upon it in a more comprehensive manner than it has been dealt with. (Applause.)

On motion of Mr. Weissleder, a committee was appointed, consisting of Messrs. Weissleder, Slattery and Hering, to report on distribution at the next meeting.

THE PRESIDENT: I would introduce Professor Fujioka, of Tokio, Japan.

PROFESSOR FUJIOKA was warmly applauded as he stepped upon the platform. He read the following paper, entitled "A Short Sketch of the Progress of Electrical Engineering in Japan": Gentlemen--As my present visit to this country, with Mr. Yashima, president of the Tokio Electric Light Company, Japan, is to investigate the different systems of electric lighting, and electric transmission of power, which are now in actual use here, so that we might introduce to our couutry the best and most reliable system, and not to make advertisements of our work, if any. I am not well prepared to give you any clear sketch of the progress of electrical engineering in our country, and I think this short paper which I have the honor to read now before such a remarkable body of electrical men as the National Electric Light Association, would be nothing but curiosity to you.

To begin with the electric telegraph, the first line was put up in 1869, if I remember right, with Breguet's A B C instrument. Since then many improvements were, of course, introduced, and now nearly all the towns, small or large, are electrically connected, so that we can telegraph from any part of our country to any part of this country, or anywhere else, only it is rather expensive, *i. e.*, about $2 80 per word from New York to Tokio. The instruments we use at present are mostly Siemens-Morse ink writers; and the wires are all overhead, except some wide rivers and straits, where, of course, subterranean cables are used. The Japanese telegraphs are completely under government control.

It was 1872 that the Imperial Engineering College was instituted in Tokio, and Prof. W. E. Ayrton, the well-known electrician now in London, occupied the chair of the Professor of Telegraph Engineering and Natural Philosophy, and stayed there for six years, working in the line of electrical researches with Prof. John Perry, then Professor of Mechanical Engineering in the same college. These two gentlemen's names are pretty familiar to you, I guess, from their valuable labors in relation to the electrical engineering and the ammeters and voltmeters of their invention. Mr. Thomas Gray, assistant to Sir W. Thomson now, stayed with us in the college for about three years, and I have been connected with the college for a number of years, attempting to keep up with the progress of electrical applications abroad. I was here in 1884, when the International Electrical Exhibition was held in this city.

The telephone business is yet quite poor in our country, only the Government offices and residences of high authorities are connected. Petitions for permission of organizing telephone companies of exchange system are made from time to time, but the Government does not permit it for some reasons or other which I cannot tell. I believe, however, it will be permitted sooner or later.

Now, as regards electric lighting, we have the Brush arc lights in some factories, mills and dockyards, and the Edison incandescent lights in some places, and among others may be mentioned 500 lamps in the Osaka Cotton Mill and 330 in the Imperial Military College.

On many occasions, such as at the ball of the Minister of Foreign Affair Department, on his Majesty the Emperor's Birthday, *i. e.*, November 3, at the opening ceremony of the Bankers' Meeting Place, and the like, we put up temporary plants with good success, and the result of this, together with the most satisfactory reports on the Edison incandescent lighting in the Osaka Cotton Mill and the Official Gazette Printing Office, induced our people to favor the electric lighting with great eagerness. The Tokio Electric Light Company which was organized some time ago, and of which Mr. S. Yashima (now in this room) is the President, has a capital of $200,000, and by the end of this year this capital will be doubled. The company has in hands the contract of lighting the new imperial palace with 2,000 incandescent lamps and 100 arc lights from the company's central station located just outside the palace ground and from which the current will also be supplied to the residences of the princess and ministers and other houses around it. It is proposed to place five or more central stations in the city of Tokio, two in Osaka, one in Kyoto, two in Nagoya and other places. Considering from the fact that the city of Tokio is ten miles square with a population of 1,000,000, and that there is now only one gas company, charging $2.50 per 1,000 cubic feet of gas and having old-fashioned gas furnaces, the Tokio Electric Light Company has a great deal to do towards the illumination of the city.

In conclusion, as there are many printing offices and small factories all over the city, using at present numerous men or steam engines, ranging from one-half to twenty horsepower, the electro-motors will also, without doubt, find good places there. I hope, gentlemen, I will be able to read a better paper when I see you next time.

MR. RIDLON: I move to give the gentleman a vote of thanks for the paper that has just been read.

THE PRESIDENT: Perhaps in view of the fact that the vote of thanks is one of the things barred in the Convention, Mr. Weeks will express our obligations to the gentleman and his colleague for the information which they have given us.

MR. WEEKS: Gentlemen of the Convention, I do not know that any further expression is necessary. I am sure our friends from abroad are pretty well assured from what our President has said that we have with them the deepest sympathy and entertain toward them the most kindly feeling. I don't know that anything further should be said. (Applause.)

MR. DE CAMP: I move that the gentleman who has just addressed us and his friend shall be elected honorary members of this Association. The motion was seconded and carried.

Election of officers followed, and resulted as announced last week. In referring to his unanimous re-election President Morrison said: To say that it is not an honor to be elected to this office would be saying what is not true and what no member of this Convention would believe if any one did have the temerity to say it. It is an honor, and one which I fully appreciate. I do not believe the Convention acts wisely in re-electing the same officers year after year. There have been men who have borne the burden and heat of the day, and that par

ticularly applies to the last six months, during which time I was relieved of the responsibility and the labor attached to the position of presiding officer of the National Electric Light Association. That relief was afforded me and those burdens and that labor undertaken by Chairman De Camp, of the Executive Committee, who has honestly and most faithfully discharged the duties which were imposed upon him. (Applause.) He has served you without fee or reward, and he, as well as others who are members of this Convention, were better fitted to discharge the duties of President of the Association than I whom you have honored with a re-election to office. A man who refuses an office of that kind and then serves; a man who declines and then accepts, can be charged not only with inconsistency (I do not spare myself any more than any one else), I say such a man can be charged justly with inconsistency, and with a view of making his services appear valuable by reason of his placing himself in a position to be coaxed to accept an office that he wants all the time. That is the position one places himself in if he accepts after declining. I do not think anyone charges me with vanity in matters of this kind; nor do I arrogate to myself all the common sense and intelligence of this Association There is a sphere in which I can operate very well, but so far as providing useful information and food for thought I ought to sit in the rear. (A voice: Oh, no). In spite of these circumstances and for the reason that so many members of the Association have come to me requesting that I should serve as its President, I have made up my mind to place myself in the embarrassing position referred to, trusting to your charity and good will towards me, which I have so often experienced since I first accepted the office of President of the National Electric Light Association. Trusting that the same kindness will be extended to me in the future that has been in the past, that you will overlook many of the faults and imperfections that I possess—and no one knows better than I do that I possess them—I say trusting to your kindly feeling, which has often been exhibited to me before, I accept and thank you for the honor you have again conferred upon me. (Applause). Before the motion to adjourn is made I think it would be better to settle on the next place of meeting. I think it is better the Convention should settle that question.

MR. UPTON: On that point I would like to make a suggestion. Mr. Barton, of the Thomson-Houston Company, expressly requested me to call the attention of the Convention to Boston as the next place of meeting.

MR. DECAMP: I beg leave to read a dispatch:—"The Boston Electric Light Company cordially invite the National Electric Light Association to hold their next meeting in Boston. F. A. Gilbert, President." I move that Boston be the place of holding the next meeting in August.

MR. DUNCAN: Before that motion is put I would like to say that I had intended to invite the Association to meet in Pittsburgh in August. But it was very evident after I came here that a large majority, at least, of the members wanted Boston, and in order that there may be no dispute upon the matter, I simply wish to put on file a request that the meeting one year from this time be held in Pittsburgh. It is a little previous, but I want it to go on record that that request has been made.

The motion to hold the next meeting at Boston was carried.

THE PRESIDENT: The Executive Committee will fix the date upon which that meeting is to be held.

Upon motion of Mr. DeCamp the Convention then adjourned.

—— The Harrisburg Car Manufacturing Company have just built a 400 horse-power Ide engine for the Union lime and cement works of Louisville, Ky., and one of 150 horse-power for the Elgin (Ill.) Electric Light Company.

ELECTRIC LIGHTING IN RELATION TO THE PATENT SYSTEM.

BY ARTHUR STEUART, OF BALTIMORE.

REFORMS IN THE PATENT SYSTEM.

Mr. President and Gentlemen, members of the National Electric Light Association:

At the last meeting of the Association in Detroit, your committee reported several important reforms that were required in the Patent Office and in the administration of the patent system. And it was resolved that the committee prepare and present to this meeting bills to be presented to Congress which would provide for the reforms which were considered expedient.

A short review of those reforms may be in place here. The present law of the United States is substantially identical with that passed by Congress in 1836. For half a century we have been working under a law excellent in its general nature and intention, but sorely defective in many of its details.

During the year 1837 there were issued by the United States Patent Office 435 patents for inventions, while the salaries of the officers employed aggregated $6,850. This was the extent of the business which existed at the time of the passage of this act and for which it was intended to provide.

During the year 1886, there were issued by the Patent Office 25,619 patents, while the aggregate salaries of the persons employed has reached the sum of $650,000.

A simple comparison of these figures will show at a glance how utterly impossible it is, that a system established fifty years ago for the conduct of a business represented by an issue of 435 patents per annum, and which has been changed only by the addition of greater force as such became necessary, can be suitable for, or cope with the questions that present themselves daily, in handling so large a mass of business as is now transacted by the office. An average of 448 patents issued every week; more than at the date of the passage of this law, were issued in a whole year.

It is easy, therefore, to appreciate how difficulties have arisen that were not contemplated by the commission that prepared this law. Many things have changed in the interval, and while the office has run along with moderate smoothness, the time has come when the importance of the subject demands the attention of Congress. It only remains for those as deeply interested as we are to knock long and loud at the doors of Congress, until we succeed in bringing its attention to the subject.

The last report of the Commissioner of patents, filed with Congress only two days ago, points out with definiteness the reforms that are needful.

LABORATORY.

The members of this Association, as I mentioned at the Detroit meeting, are most deeply interested in the erection of a laboratory to be devoted in great measure to electrical experiments for the purpose of testing appliances upon which patents are sought. Scarcely a member of this association who has been before the Patent Office with an application in this field, has not felt the great demand for facilities of this character, and the Commissioner urges its importance in his report.

EMPLOYES.

The nature of the service to the public expected of examiners in the Patent Office requires that they should be men of such high attainments as to be able to give a thorough and intelligent examination to every invention presented for patent, in order that the rights of the public may be protected, and also that a patentee may not be deluded by giving a patent on a device which, when it comes to be tested in the courts, is found to be worthless.

To accomplish this result it is necessary to pay the examiners salaries high enough to justify good men in making the service of the office a profession to which they will devote themselves, and expect to make it their life work.

PATENT OFFICE COURT.

I may be pardoned for quoting the Commissioner upon the most important subject presented for your consideration. He says:

"In my last annual report the following statement was made: 'At the present time, in addition to his administrative duties, the Commissioner is called upon to hear all cases of appeal from the rejection of a patent by the examiners-in-chief, as well as to finally hear and determine all interference cases which may be appealed to him.

"Aside from the burden which this imposes upon the head of this office, there is a want of uniformity in the decisions which emanate from time to time from the respective Commissioners of Patents which ought to be corrected. I know of no better way to correct this evil than the establishment of some tribunal to consist of at least three judges, whose tenure of office shall be fixed and to whom all appeals shall lie. I have no doubt that the establishment of such a tribunal with such jurisdiction would not only make it possible for the Commissioner to conduct a more successful administration of his office, but would secure to inventors and to the public a much more intelligent and uniform exposition of the law of patents and of the important questions which now of necessity must be determined so hastily."

"I again invite attention to this subject for the purpose of asserting that my experience of the year last past has not only confirmed me in views which I then expressed, but has made much more manifest to me the necessity for some legislation of this character. A court of sufficient dignity and strength ought to be created, and such tribunal might very properly be invested with final jurisdiction in all matters pertaining to the patentability of an alleged invention as well as all matters of interference between litigating applicants. Such a court with such jurisdiction would not only result in leaving the Commissioner free to attend to the other pressing duties of his office, but would inevitably relieve the Federal courts of much of the litigation upon these subjects with which they are now burdened."

Here is the deliberate judgment of the man best fitted to judge of the needs of the office and the changes that would accomplish the results desired. A court such as that suggested by the Commissioner would have the effect:

I—Of making the practice of the Patent Office uniform and logical, and those of you who have much business with the office know how great a gain that will be.

II—It will merge in one tribunal that will never die or go out of office, the decision of all the questions now passed upon by the Commissioner of Patents, the Examiner of Interferences, and the Board of Examiners in Chief, and as a result we may expect to get uniformity and a logical connection in its rulings upon subjects closely related, but now passed upon by several different officers.

III—The decisions of such a court, if made co-equal with the Circuit Courts of the United States, would be *res adjudicata* whenever called up in them; thus relieving those courts of the necessity of examining into questions of patentability when they arise in the trial of patent cases.

IV—It might also be well to give this court original jurisdiction in cases for infringement of patents. Such a court would offer to all those who came before it the inestimable advantage of a knowledge of and interest in patents which would insure to the patentee an intelligent hearing and a disposition to give him all that he was entitled to under his patent.

COMMISSION.

The next question to be considered is, how are these results to be accomplished? It is very difficult, as we all know, to persuade Congress that the measures that commend themselves to our minds as desirable will either meet with the approval or accomplish the results that others equally as intelligent and interested as ourselves may have in view.

I think the Commissioner of Patents has suggested the proper course when he says, in concluding his report:

"I feel so confident that changes and modifications too numerous to be dwelt upon in detail, or to be pointed in this report, of a substantial character which would materially affect the prosperity and usefulness of this office entire, are imperatively needed, that I cannot refrain from concluding by again urging upon Congress the necessity of providing in some way, by commission, or otherwise, for a complete and exhaustive revision of the entire legislation and probably of the rules which affect this office."

The surest road to the results we have in view would be the appointment of a commission by Congress to examine the whole patent system as it is at present, both the branch under which patents are granted, that is to say the Patent Office, and that under which patents are litigated and rights under them determined by the courts, and to report to Congress an act that will provide for such changes as this commission shall find necessary and desirable. Such a commission created by Congress and appointed by the President, could give to the subject a most full and intelligent consideration, and when their report was formulated into an act it would without doubt be passed as they prepared it. We could feel that we had a law commensurate with the development of the subject, and one that would successfully and satisfactorily cope with it.

I have prepared a bill to be presented to Congress, which provides for the creation of such a commission, and it remains with you to adopt it here, and then urge it upon the attention of Congress with sufficient earnestness to secure its passage. The present Congress goes out of existence on the 4th of March, and before that time it must be pushed through both houses if it is to become a law. It is very desirable that this commission should be appointed at this session, in order that its report may be submitted to the next Congress.

The bill will be filed at once, and each member of the Association is earnestly requested to take the matter up and use all the power at his command to urge its passage upon the members of the Senate and House of Representatives.

PATENTS, TRADE-MARKS AND COPYRIGHTS—A BILL

Creating a commission to examine and report to Congress needful reforms in the patent system.

Whereas, the patent, trade-mark and copyright laws of the United States are deemed to be in such a condition as to require revision, therefore:

Be it enacted by the Senate and House of Representatives of the United States in Congress assembled:

Sec. 1. That a commission be, and the same is hereby created, to consist of three suitable persons to be appointed by the President of the United States, who shall hold office until a final report of this commission is submitted to and accepted by Congress. And who shall receive for their services a compensation of $5,000 each per annum.

Sec. 2. It shall be the duty of this commission to examine thoroughly the present patent, trade-mark and copyright laws of the United States, and those of other countries, and their practical operation and effect in meeting the needs of the public and fulfilling the purposes for which they were created. To formulate a report to be submitted to the next Congress, which shall set forth the results of this investigation, and their conclusions therefrom with reference to changes in or additions to the present law pertaining to patents, trade-marks and copyrights. This report shall also contain a draft of an act which will provide for the changes found necessary by the investigations of the commission.

Sec. 3. The commission is authorized to employ such clerical force as may be necessary for the proper conduct of its work, and to incur such other expenses for stationary, printing, etc., as may be found expedient.

Sec. 4. The salaries of the members of this commission, as well as all expenses legitimately incident to its work, shall be paid

from the surplus in the United States Treasury to the credit of the Patent Office.

All expenditures by or for said commission, other than the salaries of the members, shall, however, be under the control of, and authorized by, the Secretary of the Interior.

REMARKS OF CHIEF EXAMINER KINTER IN RELATION TO PATENT OFFICE REFORM.

THE PRESIDENT: Mr. Kinter, from the Patent Office at Washington, is here, and as he has to leave in ten minutes, and in connection with the matter of Mr. Steuart's report, we would be glad if Mr. Kintner would come upon the platform and address the Convention.

MR. C. J. KINTNER: *Mr. President and Gentlemen of the Convention:* I am only accidentally in the city upon other business, and it gives me pleasure, I assure you, to be able to say a few words in respect to the subject of Mr. Steuart's very able report of yesterday. I was advised of it in this morning's paper, and read it with great interest, and I assure you I heartily commend it, and all the efforts which you gentlemen on the outside of the Patent Office are making. If you could but appreciate the position which I, as a public officer, am forced to hold, with the limited material at my disposal, and with the advantages which you as scientific gentlemen and experts must necessarily possess, you would see how difficult it is for me to carry on in anything like a successful manner the business of properly examining applications which come before the Patent Office. I profess to be theoretically, perhaps, as well prepared as most of you to cope with these questions, but I had not the apparatus there which any well-organized institution like the Patent Office should have. To-day we have in the Patent Office a laboratory, the total material of which cost less than $500, purchased by the Department during the time that I was chief clerk. We have one small hand dynamo, given us by the Van Depoele Company. We have, perhaps, a thousand cells of battery. We have no testing apparatus whatever. Through the generosity of some corporations we have been enabled to have a telephone line extended to the building, and are sometimes able to test telephone apparatus for long distance. But, gentlemen, it is not with the Patent Office. The whole matter lies in your hands. A little over a year ago it became my privilege as chief of that division to recommend to the Commissioner of Patents a system which, in my opinion, would put the experts of the Patent Office on a par with yourselves in every respect. I recommended in that report that a central plant be stationed within the court of the building; that a workshop be organized, and that a system of heating and lighting be combined by which it would be possible to heat the building and light the building, and the entire expenses of the apparatus would be paid for by itself. But this matter has been rehashed time and again within the Patent Office, and I have never been able to do anything which will give me any aid in that direction. If you will look back over the records of the Commissioner of Patents for the past twenty years you will find the same old story—want of room, want of force. We turn out patents, of which I will venture to say four-fifths will be sustained in the courts, and it is marvelous how we do it. When I entered the Electrical Division as assistant, in 1880, there were less than 2,000 patents. To-day there are over 12,000 patents. We are receiving over 3,000 applications, and grant from ten to fifteen hundred new patents a year. We are doing it with nine assistants, and I have found the work so laborious that within the past year it became necessary to make two divisions, known as Classes A and B, of which I have charge of one, and Mr. Seeler the other; the classes being divided on the line of generation and use.

The whole matter lies in your hands. You as the inventors, you as the persons who are the power behind the throne, must go forward in order that this thing may be done. It was not within the power of the Commissioner of Patents. He has a thousand and one other things to which it is necessary for him to attend. The Electrical Division is but one of the twenty-six divisions of the Patent Office. But in order, as I said before, that the examining system may be properly conducted, it is necessary first to provide a proper laboratory with testing apparatus, and Mr. Steuart's proposition is certainly in the right direction. I do not know that I can add anything to what has been stated by him as to the course that should be pursued. His idea in regard to a court is eminently proper for this reason—and I want to give you a point right here in that direction—the system of appeals in the Patent Office is, if I may use a vulgar expression, tail end to. The Examiner in charge of the division passes upon the novelty of the case or upon the merits of the case, and he is appealed from on matters of expert knowledge to a Board of Examiners in Chief, who have, it is fair to say, a creditable knowledge of electrical matters. But they are not experts in that line. From that an appeal lies to the Commissioner of Patents, who does not pretend to be an expert in this matter, but who is necessarily an able man in the law. An appeal from him lies to one of the Judges of the Supreme Court of the District of Columbia, and thence by bill in equity to the Supreme Court of the United States. But it would be advisable to provide such a court as Mr. Steuart has recommended, and that court should sit upon all patent cases and necessarily all cases of infringement should be appealed to that court. The necessity of that is seen when we realize how very important the patent system has grown in this country.

I don't know that I can do more, gentlemen, than to say that I hope that you will put your shoulders to the wheel in this matter and to say that I am pleading for this matter not in my own behalf, because I do not expect to remain in the Patent Office more than a year longer. Since I have been connected with the Department three principal Examiners have left it, and nine assistants. We are constantly receiving tempting offers to use our experience on the outside. So I make this appeal to you, not that it may be of any benefit to me as an attache of the Patent Office, but that it may be of benefit to the office in the future, and that I may avail myself of that benefit. (Applause).

Report of Electric Light Committee to New England Insurance Exchange.

This Report was submitted to the Electric Light Convention and read as follows:

BOSTON, January 22, 1887.

To the New England Insurance Exchange:

MR. PRESIDENT AND GENTLEMEN—Your Committee on Electric Lights is now about entering upon its fourth year of duty.

Some idea of the amount of work performed by and under the direction of the committee may be had from the fact that its records show 9,452 arc and 48,716 incandescent lamps in operation in New England at the beginning of this year. The records are, however, somewhat incomplete, in consequence of the partially unsystematic method of inspection that was at first unavoidable, so that it would be entirely safe to estimate the actual number of electric lamps now in use on premises insured by the Exchange companies at 10,000 arc and 50,000 incandescent; and in this calculation no account is taken of the considerable amount of inspection that was made in New Hampshire before the retirement of our companies from that State, in September, 1885.

In view of the very slight loss record in our territory from electric lights, it will naturally be asked by some, and particularly by those engaged in furnishing electric light: Does the necessity exist for such systematic and rigid inspection? To this your committee simply answers, Yes, and would reiterate what it has always maintained in its dealings with electric light people, namely, that the system, properly guided by a knowledge of electrical laws, and guarded by the various well-known automatic safety devices and current regulators, stands pre-eminently as the safest method of artificial lighting in vogue. But, on the other hand, once remove the wholesome restraint of expert supervision, and the mad race of competition between the constantly-increasing number of candidates for public favor in the electrical field would soon lower the standard of their work, until its dangers could only be computed by the disastrous results that would inevitably follow. In support of this statement, it is only necessary to quote from the report made last September by an insurance committee appointed in one of the large Middle States to inquire into the question of losses occasioned by electric lights, and to recommend some action, no systematic inspection having been carried on by those underwriters up to that time.

That committee, after a careful investigation of the subject, believes that the loss from that cause in their territory is more than two hundred thousand dollars per annum, and is on the increase; hence, they consider "that it is none too soon to adopt some measures for self-protection." After pointing out the most frequent defects and causes of fires, and suggesting the remedies, together with a general synopsis of rules for the safe construction and maintenance of all electric light apparatus, they conclude by recommending that all wires in the larger cities or towns be put underground, and that a certificate and guarantee be required of the electric light company in each case where a permit is asked for, that the apparatus is in accordance with their rules, and that the electric light company will be responsible for any loss or damage occasioned by faulty construction, short circuit, or contact with other wires; and with or without this guarantee they propose charges of extra premium as follows:

For incandescent light with guarantee, no charge.

For incandescent light without guarantee, 10 cents.

For arc light with guarantee, 10 cents.

For arc light without guarantee, 25 cents.

Your committee confess the belief that the above is a radical view, but it is the very natural outgrowth of an expensive experience brought on by allowing electric light competition in the hands of both skilled and unskilled persons to run riot in their field; and we say with them, "It is none to soon" to act.

We sincerely hope that the time may come when the science of electric lighting, and the natural laws which should govern it, will be so well understood and adhered to by all those engaged in the business of furnishing electric light and power that no need for inspection on our part will exist, but that bright spot in the horizon has not yet made its appearance.

The first duty of the committee was to arrange a plan for inspection and rules whereby to govern the introduction of electric lights Previous to our appointment the work had been performed for the "Exchange" by the inspector of the "Boston Tariff Association," which had carried on a system of inspection under rules of its own for some time. A set of rules and requirements was at once formulated by us, and local inspectors, selected from the telegraph and telephone fraternities, were appointed at various places throughout New England.

This system of local inspectors seemed to answer the purpose very well for a time, but in consequence of the very rapid introduction of new devices, with which the inspectors were entirely unacquainted, and which devices could not be absolutely provided for in any set of rules, a variety of opinions and decisions, and a great deal of correspondence with the committee, were the very unsatisfactory results. The effect of all this was that the same electric light company operating in different localities would receive as many different decisions as there were inspectors that examined their apparatus.

This condition of affairs, coupled with the question of expense incurred in the employment of inspectors, forced upon your committee the necessity of having the work done by one man, who, by giving his whole time and attention to the subject, might be qualified to meet and dispose of all questions in a manner satisfactory and equitable to the electric lighting interests, and with safety to our own.

In the early part of last year your committee was given authority to secure the services of a chief inspector, and on the first of April we employed Capt. Wm. Brophy.

Previous to this, specific charges for services of inspectors had been collected from the various local electric light companies, and this method had been the occasion for considerable annoyance, for the reason that in some instances the work of constructing the lines had been performed by one party, the equipment and furnishing of the apparatus by another, and the local company that was to operate the plant was composed partly of local capital, and partly of the company whose system of lighting had been installed; thus the question of liability for the payment of inspectors' fees was shifted from one to another, and denied by all. Therefore the only satisfactory solution seemed to lie in the course finally adopted by the committee, namely, that of apportioning between the various systems or parent companies, the whole sum required for compensation and traveling expenses of our inspectors for a given period.

This apportionment was made from the first of April last, on the basis of the amount of work then being done by each system in our territory, as shown by our records.

As any process that exacts money for no apparent value received, generally meets with some opposition, so was this one of ours no exception to the general rule. We found no company that was not perfectly willing, and even anxious, that we should inspect their apparatus, and give our approval and endorsement, for the benefit of their customers; but we found some of them quite as unwilling to pay for the actual cost incurred by us in the employment of the necessary expert services. The query was constantly being propounded to us, "Why do you ask electric light companies to pay for the inspection of their work, when you make no charge to gas companies, or for inspecting any other method of lighting?" Of course, the answer to this was simple, but it involved considerable argument and correspondence. They did not seem able, or willing, at least, to understand that while any unscientific (?) insurance inspector could skillfully examine and pass judgment upon a gas jet or a kerosene lamp, he was not equally qualified to pronounce his verdict upon the mysteries of a science that, alas! too many of those engaged in the business of electric lighting are themselves sadly deficient in the knowledge of.

We are happy to record, however, that this point of view was the exception, rather than the rule.

It was even insinuated to us that our assessment was a "scheme" to provide a "fat position," a sinecure, for some one; but we are at a loss to know who enjoys the fruits of any such office. Surely it is not our inspector, for we believe he is the least-paid man in the business, considering the character and amount of the work he has to do; nor do we feel that the gratuitous and annoying duties of the committee savor of the bonanza. The fact is that about two-thirds of the whole sum we receive is paid for railroad and hotel expenses, so constantly is our inspector kept upon the road.

An assessment in accordance with the plan above stated was levied, covering the period from April to October, and a subsequent one from October to January of the present year, with the satisfactory results that were shown in your treasurer's annual report. It is the purpose of the committee to re-apportion the assessment from year to year, according to the variations of the work that appears to have been done during each past year, by the various companies.

Owing to the rapid development of devices for generating, distributing and governing electric light currents, the committee found it necessary as early as the year 1885 to devise new rules and requirements for the use of lighting companies and our inspectors; and accordingly, in September of that year, we issued new sets, separately, for arc and incandescent service. In the arrange-

ment of these we were largely aided by the experience and information of our present inspector and some of the leading electric light people; and we have reason to believe that our rules have been a source of education to some engaged in the electric-lighting business, perhaps to the detriment of the more scientific pioneers. Indeed, were we again to begin at the beginning, with our present knowledge, we think we would be inclined, in justice to all concerned, to issue rules setting forth those practices that we would not permit, rather than stating in such complete detail what should be done.

Since we employed Capt. Brophy, he has carefully inspected nine central stations in the State of Maine, with their ramifications, employing 2,540 lights; three in Vermont, with 1,410 lights; thirty-seven in Massachusetts, with 28,130 lights; four in Rhode Island, with 3,046 lights; eighteen in Connecticut, with 3,785 lights; besides forty-seven isolated arc plants, employing 942 lights, and ninety-three isolated incandescent plants, employing 18,315 lights.

Frequent visits by him were necessary to many of these plants, in order to satisfy himself that changes and improvements which he had suggested had been properly carried out. You can readily perceive that time has not been a burden to the "Captain."

It is the understanding with all the electric light companies that his services, in any capacity that concerns our interests, are at their command, and so frequently is he called upon for information and suggestions as to what will be approved by us, that it is rarely the case now that any new method or device is put into use before having received his approval; hence much work that, under the old system of inspection, we were obliged to disapprove and condemn, is now readily accepted.

In two instances during the past year, our inspector has found it necessary to ask for the removal of incompetent superintendents of central stations, believing their retention to be a source of danger to us, and of disadvantage to their employers. In both of these cases investigation proved the correctness of his views, and resulted in a cheerful compliance with his request.

It is not uncommon that he finds it necessary to devote considerable time to instructing employes in their duties as dynamo and linemen, many of whom have a very inadequate knowledge of electrical laws, or the serious results that might ensue through carelessness or lack of knowledge on their part. Incredible as the statement may seem, it is a lamentable fact, that men have been found in charge of stations, who thought that the use of a fusible plug or "safety-catch," was to gauge the flow of current, the same as a valve in a water or steam pipe, instead of being there to open the circuit in case of an abnormal or dangerous flow. We believe that many a new-comer, with his brand new "system" to offer to the public, does not fervently pray for a second visit from our inspector. Various methods employed in the business have been discarded through his disapproval, to the great benefit of all concerned. Devices known as "multiple series boxes," for incandescent lamps in arc light circuits, which opened out with such apparently bright prospects for their promoters, are not now used to any great extent—for which we have reason to feel thankful. Incandescent lamps of large candle-power, in series, are being introduced to a limited extent, but their introduction is being carefully watched, and we hope they will not gain an extended foothold. Two or more systems for converting high potential or arc currents, into low potential or incandescent currents, are being developed; but they are receiving the careful attention of our inspector, and the "converters" have not yet been admitted to the inside of buildings, except at the factories and houses of the electricians, in an experimental way. A large majority of the comparatively few fires from electric light causes, that have occurred within our field, have been from the arc system, and mainly from bad connections at the lamps, and broken globes. Joints or splices are prohibited, as far as possible, particularly inside of or near buildings, as there is always a liability, in making a splice, that the area of contact may be reduced, and thereby friction and dangerously heated wire ensue. Arc lamps depending upon their own weight to make electrical contact with the main wires, are a source of much danger, because of their liability to get displaced through the carelessness of the trimmer, or otherwise; in which case the contact may become lessened, or partially broken, resulting in overheating, and possibly a dangerous arc, near woodwork. We have endeavored to entirely exclude this kind of lamp from the inside of buildings, but nothing short of constant watching on our part could accomplish this result absolutely. The failure of an arc lamp to feed, by reason of defects in the shunt, may cause trouble, but this can be avoided by the careful attention of the trimmer to his duties. Broken globes cannot be prevented, but our rules provide that they shall be immediately replaced with perfect ones, and where that is not done, the trimmer is again remiss. Thus it will be seen that not only the apparatus, but the employe as well, needs inspecting.

With the incandescent multiple system, the danger is mainly from a possible excess of current over any branch, if the path is left open to it; but this danger is well provided against by the "safety catch," which fuses and breaks the circuit when the excess goes beyond the capacity of the "safety catch." But of what value is this device when, alas! it is a dummy, or when the electrician in charge, supposing the purpose of the "safety-catch" to be that of a "current-regulator," or "gauge," has placed a 30-ampere plug in a 5-ampere circuit? These mistakes (?) do not often occur, we are pleased to say, but they are a part of the record of our experience.

We quote here the words of Capt. Brophy, which state quite clearly the present condition of things. He says: "While new systems are being sprung on us daily; while the manufacturers of electric lighting apparatus, owing to sharp competition, will sell cheaply to secure contracts and shave in their work to secure a profit; while they will tell their customer that the hiring of skilled workmen to look after and care for their particular style of apparatus is entirely unnecessary; and while the said customer, acting under such advice, employs cheap and unskilled workmen to perform duties beyond their comprehension—while this state of things lasts, 'eternal vigilance is the price of our safety.'" Continuing, he says, "The great want of the electric lighting business to-day, is competent men; but, unfortunately, the supply does not keep pace with the demand, notwithstanding that at least one institution is rapidly turning out what are labeled and offered to the trade as 'Experts.'"

In September of last year, the Providence Board of Fire Underwriters, which had up to that time supervised electric lights in that city and Pawtucket through an inspector of their own, voluntarily put the matter into our hands, and adopted the "Exchange" form of permit, they having encountered some opposition from the lighting companies. We believe that they now acknowledge themselves to be quite happy in being relieved of the responsibility, while the burden upon your committee is not perceptibly increased, and our inspector seems equal to the additional work. We may say that the whole of New England, outside of the city of Boston and the State of New Hampshire, is now under the watchful eye of our inspector, unless we except the city of Hartford. An invitation was cordially extended to the Board there to join our ranks in this particular work, but we regret to say that an entirely unwarranted feeling, to the effect that we wished to usurp the control of their affairs, seemed to prevail among them; so, after courteously disowning any such purpose or wish on our part, the correspondence was discontinued.

It may be well to add a few words as to the *modus operandi* of our inspection system, which is doubtless familiar to most of you. Such has been the effect of our supervision in elevating the standard of work, that we do not now deem it necessary to examine all apparatus before granting permits; therefore we ask of agents that they procure from the lighting company a certificate, which gives notice of the installation of the apparatus, certifies to its being in compliance with our requirements, guarantees that no change shall be made except in conformity therewith, and that due notice of any change shall also be given us. This certificate goes to the Local Board Secretary, who furnishes all Board members with the name and location of the premises, and forwards the certificate to the "Exchange," whereupon permits may be granted. We rely upon this certificate until such time as our inspector can, with economy of time and travel, reach the place. No annoying hindrance is occasioned to the lighting people, and we seldom find that our trust in them is misplaced to any serious extent. By this process, if faithfully carried out, every agent has in his possession a complete list of the lights in use in his territory, and if a location appears upon his list, that is his authority for granting permits. A complete list of all the lights of course appears upon the "Exchange" records. A standard form of permit is furnished by us, and if used exclusively by every agent, as we request, a mere glance in passing daily reports is sufficient to determine the genuineness of the permit, and give assurance that the lights will receive our attention in due course.

In conclusion, we can only repeat the hope that in the near future, this rigid and laborious system will not be necessary on our part, but before that can be realized the science must emerge from its experimental stages.

Respectfully submitted,

S. E. BARTON,

Chairman Electric Light Committee.

An Electrical "Treat."

"I think I'll take my electricity," said a member of Congress, as he came out of the House into the lobby. "I feel all worn out; that last speech has almost exhausted me. Won't you come along?" he asked of a fellow member. "I don't mind," the second Congressman replied. "I think a little will do me good, too." The two members got on the elevator and went down to the basement to take their electricity. It is quite "the fad" nowadays for the members to take electricity. An electric apparatus has been fixed up in the engine-room in the basement, and daily the members avail themselves of the opportunity to get freshened up. A board, with a tooth-piece of copper, is placed beneath the great belt of the large engine wheel, and the electricity thus generated is carried off by a wire attached to the board, which is long enough to be grasped by one who sits in a chair near-by. The circuit is completed by the person holding the wire grasping a small brass chain attached to the railing around the engine's wheel. The system is thus filled quietly with electricity. The members say it is splendid after they have been out to receptions and suppers all night, or after they have exhausted their brain power by speech-making or listening. A great many members take electricity, and some go to the basement of the Capitol for it every day during the session.

Answers to Correspondents.

R. E. M., Hazleton, Pa. Very many attempts have been made to accomplish the end sought, but the mechanical result, if your diagram is understood, would hardly result as hoped. The long distance people (American Telephone and Telegraph Co., 15 Cortlandt street, N. Y.) can, perhaps, aid you in showing how they virtually accomplish the same result in a very different way.

EDS. REVIEW.

—— The Armington & Sims Engine Company of Providence, R. I., have sold to the Edison Company, and the different Edison Illuminating Companies of this system over 100 engines.

TRANSMISSION OF POWER.

ADDRESS OF MR. F. J. SPRAGUE ON "ELECTRIC MOTORS," BEFORE THE NATIONAL ELECTRIC LIGHT ASSOCIATION, FEB. 16, '87.

The Chairman introduced Mr. F. J. Sprague, of New York, who spoke as follows:

MR. CHAIRMAN AND GENTLEMEN OF THE ASSOCIATION: I feel that I owe you an apology, as I see that it is stated on the programme that I am to read a paper on the transmission of power. The duties, however, which have devolved upon me during the past two or three weeks have been of such a character and demanded so much of time that it has been simply impossible for me to write a word on the subject in question. What I have to say will, therefore, be entirely extemporaneous; and if there is a lack of logical sequence in my statements, or I omit any important points, I trust you will excuse me. I may also add that I am almost physically unable to say anything at all, and it is only because I promised Mr. Morrison and some others that I would address you that I have consented to make any remarks.

The time has come for us to look upon the distribution of power in a light altogether different from that in which it was viewed three years, or even one year ago. We have heard about electric motors, and we have talked about the possibilities of the transmission of power ever since Pacinotti ran his first motor. But motors were run primarily with batteries, and it is only recently that they have been operated in connection with central stations.

They have been made of small sizes and treated as toys; and more batteries and motors have been invented than there have been made variations in the steam engine, but we have never reached any position from which we could show a commercial return from the use of electric motors until the last year or two.

The distribution of power by electricity, so long looked upon as a visionary and to-be-hoped-for attainment, is now an accomplished fact. It is in its infancy, but it has a future probably second to no other enterprise in the commercial world. It is not necessary here to give a scientific explanation of the operation of a motor. I will try to briefly show that electricity will fill the field in a far more complete and satisfactory manner than, but in very much the same general way as, does the distribution of power from a central station by means of gas, steam, water, or compressed air. The use of any of these elements for this purpose is an engineering problem. To be successfully solved—not alone scientifically, but commercially—every part of such system must be in thorough accord with every other part. It is not enough that there shall be a good dynamo or that there shall be a good motor, but that the dynamos and motors shall be built for certain specific electromotive forces definitely related to each other, and that the conductors should be put in for the distribution of given amounts of energy to the motors under given losses, and the motors should have an efficiency that is not visionary or sought after, but which is just as well known as the characteristics of any part of the system.

In considering this question, however, we are confronted with grave responsibilities and many difficulties, and those who assume to advise the general public cannot be too careful of their utterances. We have to consider the state of the art and of the people's knowledge on the subject. We have to even contend against the ignorance of people in charge of central stations, and we have to contend against a much worse element—the ignorance of the general public concerning electricity. With steam we do not have to deal with this difficulty at all. Trained and experienced engineers can be secured without number. They can be hired by the week or month to care for an engine; and since all engines are based upon nearly the same principles and are practically alike in their operation, no difficulty is experienced in getting good men to care for a five, twenty-five, fifty or a hundred horse-power engine.

This is not the case with electric motors. We are obliged to depend upon the central station managers, and those who they especially train.

The practical questions which arise are: Who are to exploit this business? Who are to be actively interested in the extension of this system for the transmission of power?

There are two representative industries already in the field. The first to come was the arc light; then the incandescent light, and now, finally, comes the transmission of power for industrial purposes. There have, in consequence of the order of development of these three different methods of using electricity generated at a central station, arisen three different companies, more or less antagonistic to each other, but which ought to be working in harmony.

No one can doubt that if, ten years ago, the arc light in its present stage of development, the incandescent light in its present perfection and the electric motor as efficient as it is to-day, were all three at the same time presented to capitalists as commercial investments, all three would have been taken up by the same men on a broad, comprehensive plan, and each would have held its own particular field and would have been pushed with the same energy and success that they have been individually; and that, instead of there being more or less of a rivalry between these three branches of industry, they would have been operated under one control, one general expense and one profit.

An illustration of their natural unity of interest is afforded by the action of the various companies representing these different branches. Arc light companies are operating incandescent light, incandescent light companies are running arc circuits; both are beginning to use motors, and I suppose some of the future motor companies may be rash enough to supply lights.

But since we have to deal with existing conditions and vested rights and privileges, let us briefly consider the various organizations which can be instrumental in developing this new field of work, and the methods by which they may be successful. As being in the position to actively take up this work, I may mention, first,

ARC LIGHT COMPANIES.

A very large number of existing companies have already secured free franchises which it would be difficult for other companies to obtain. Some of these companies are to day just barely meeting their running expenses, because they are supplying power for lights for only a fraction of the day or night in close competition with the gas interests, and perhaps with other electric light companies. The demand for arc light varying of course, at different times of the year, the receipts vary above and below the operating expenses. All through the day, till perhaps five in the afternoon, these stations lie idle. Such companies have their poles erected, their lines run, and certain franchises in their possession, and it would be an easy matter for these same companies to run lines for the distribution of power on the same poles as carry their arc light circuits. The wiring for this purpose would be very simple. In some cases the poles would have to be reinforced; in others it would not be so. For running these lines to supply power alone, constant potentials as high as 400 volts could be used with perfect safety, and this would very much reduce the size of the wire.

INCANDESCENT LIGHT STATIONS.

Many of these run only in the day time, and do not begin their lighting until late in the afternoon. The bulk of their lighting terminates long before midnight. Other of these stations run during the day, because they find the necessity of supplying a few lights in the daytime, to get certain contracts for night work, but almost invariably this day running is at a loss. These companies already have their lines run to supply power on constant potential circuits—some overhead and others underground. Since the power would begin in the morning, and continue for a general average until the latter part of the afternoon, and then begin to fall off, and the light at the same time begin to come on, such a station if worked, up to its full capacity, ought to have an almost continuous load from morning until late at night; the load being first almost entirely of power, then of light and power combined, and finally almost entirely of light.

GAS PLANTS.

The gas engine, although it has made great strides in England, does not stand in high favor to-day in the United States. A gas engine will not work up to the capacity at which it is sold, and at which it is nominally rated. It will fall off anywhere from 25 to 50 per cent. below this. Its motionis necessarily irregular and uncertain, because during a large part of its rotation it is dependent upon the inertia of the fly-wheel. Such machines are necessarily more costly than electric motors of the same capacity, such cost being about double. They are noisy, they cause a great deal of heat, and they are uncertain. Their advance in England was made before electric motors were as practical as they are to-day, and where gas is sold at a very much lower rate than it will be possible to get it for in the United States for many years to come. The electric motor, then, can easily compete against the gas engine when put side by side, both in initial cost and expense of operation. It is likewise more compact and has an excess capacity—a quality that is never claimed for a gas engine. Gas works have among their residual products coke, which is of very little value. By putting in good generators, running wires for the supply of power alone, and putting the generators and dynamos in the charge of the men who are already employed at the gas works, they could produce their power and sell it at a very advantageous price. Their office rent, officials' salaries, and attendance would be reduced to a minimum.

SPECIAL STATIONS.

These should be put in good manufacturing and industrial districts, and preparations made to supply any demand for power, from a half horse-power up to one hundred or more horse-power. There is no possible question that when a large number of motors are supplied from one district, even when dealing with large powers, electricity can successfully compete against steam.

Double circuits can be used, small powers being supplied at 100 volts, and large ones at 400. Such stations should be built to get the steam power at the lowest cost, and hence should have the best engine and the best method of fuel consumption. The district covered will depend upon the location of the station. If this is central, two or four square miles can be easily covered.

I will now consider the different classes of circuits on which motors may be used.

First. Arc light, or constant current circuits, in which the current supplied to the motor is kept constant at a certain number of amperes, ranging from six to nineteen amperes in different systems. The electromotive force at the terminals of the motor varies with the load.

Second. Constant potential, or incandescent light circuits, in which the difference of potential at the terminals of the machines is kept practically constant while the current varies with the load.

Third. Circuit, in which the current and the potential both vary, as is the case where there is an appreciable drop or fall of potential on connecting lines somewhat removed from the source of power of a constant potential system.

I am now operating on all classes of these circuits, but since, because of the small ampere capacity of the current on arc light circuits, any large power must require a great difference of potential at the motor terminals, and variations of power will cause sudden and great changes of potential, the arc light circuits have principally been used in conjunction with arc lights for transmission of small powers only, or for constant work.

In considering the transmission of power as an industry—that is, in a broad and comprehensive way, and not as an adjunct to some system of lighting—I may here state that practical and theoretical considerations make it imperative that the constant potential method of distribution is the only safe and feasible one. Since I make this statement, it is incumbent upon me to explain the reasons. The only existing constant current circuits are sed primarily for the operation of arc lights. At present, as I have said, these range in capacity from nineteen to six amperes. The unit of light which is required for general purposes necessitates an expenditure of about half a horse power of electrical energy. A greater expenditure would be extravagance. In order to keep the size of the conductors as small as possible, and to allow long extended circuits, the tendency is to reduce the amperes to the smallest number.

The conditions of an arc light probably will not allow this to go below about six amperes; the more ordinary unit is about nine and a half. The commercial conditions unquestionably will not permit, in the future, of a much higher ampere capacity, because the size of the wire varies as the square of the current used. Now with a nine and a half ampere current, a motor to develop one horse power—supposing it to have an efficiency of eighty per cent.—must have supplied to its terminals 933 watts of electrical energy. In other words, there would be at the terminals of the machine an electromotive force of about 98 volts for each horse power developed? Suppose, now, we want to transmit one hundred horse power; it would then be necessary (if the motor be of the same efficiency) to supply to the motor 93,250 watts of electrical energy; and, if on this 9½ ampere circuit, we would have an electromotive force of over 9,800 volts.

Now in practice, arc light circuits vary from, say, 1,000 to 2,500 volts. On a 1,000-volt circuit you could recover about ten-horse power; on a 2,500 volt circuit about twenty-five horse power. In other words, existing arc light machines, if devoted entirely to the transmission of power, are limited to the actual development—on even the largest machines in ordinary use—of twenty-five horse-power; and, if used in combination with light, there would not be available on any particular circuit over a small fraction of this. Now, if you are going to consider motors as toys—if you are going to deal with the transmission of the tenth of a horse power, or one-half horse power, or a one horse power unit, and are willing to have the element of danger as well enter into these small transmissions, then you can work with an arc light circuit; but if you are going to transmit units of five, ten, fifteen, twenty, or twenty-five horse power, you cannot deal with the arc light circuit; it is utterly impossible.

In Boston we have recently put upon certain lines nearly two hundred horse power. Suppose this were supplied at 9½ ampere circuits. Not less than eight circuits of 2,500 volts each would be required—and probably more, because with units as high as fifteen horse power, and this division of circuits the law of general average could not come into play but in a very limited way.

These eight 2,500 volt circuit represent the capacity of a 460 arc lamp station, and to deliver the power not a single lamp could be used at the same time. Does any one really suppose that by this method of working, leaving out for the present all question of danger and unreliability, the same results could be obtained as are in fact to-day? The constant current method of distributing power is the limited and unnatural method; the constant potential, the comprehensive and natural method. This is a fact entirely independent of the question of relative electrical potentials, because of the constant potential circuit we can work at a 100, 500, 1,000 or 2,000 volts, if we please.

In Boston we at present transmit up to 4,800 feet on a 200 volt circuit.

When dealing with the question of power alone, and with an area of, say four square miles, the station being near the center, I would prefer to work with 400 volts. Remember then that power transmitted means the transference of a given number of watts of energy. It is expressed by two products—quantity and pressure. If one is increased the other may be reduced. If small conductors are to be used, then it is essential that small currents shall be used, and of necessity high electromotive forces, even when operating on a constant potential circuit.

When dealing with short distances and small powers, it is better to use low potentials; but when dealing with large powers and long distances it is absolutely necessary to use high potentials, because the commercial conditions will allow only a certain proportionate investment in copper. There are certain laws to which it is well to call your attention, as they may serve to make more clear some of the questions which come to you.

First. With any given work done by a motor, loss of power on the lines, electromotive force at the terminals of the motor, and distribution, the weight of copper varies as the square of the distance. That is, if the distance is doubled with these given conditions, four times the weight of copper will be required.

Second. With the same conditions, the weight will vary inversely as the square of the electromotive force used at the motor. That is, if using double the electromotive force at the motor, it is necessary to use only one-quarter of the weight of wire.

Another way of expressing this is, that if the weight of copper is fixed, then with any given amount of power transmitted and a given loss in distribution, the distance over which the power can be transmitted can be increased in directly the same ratio as is the electromotive force. For example, if a thousand pounds of copper is required to transmit a given amount of power with a given loss, and it is desired to double the distance with the same weight of copper, then the electromotive force must be doubled.

Again, with the same cross section of conductor, the distance over which a given amount of power can be transmitted will vary as the square of the electromotive force.

Another way of expressing these laws is by means of a formula which I have been using for a long time, and which you will find of service in determining the size of wire to use in the transmission of power. Let

L = distance between the generating and receiving stations.

n = number of effective horse-power to be delivered on the motor shaft.

E = electromotive force at the terminals of the motor.

v = number of volts fall of potentials on the line, E + v being, of course, the electromotive force at the beginning of the line.

K = efficiency of the motor.

C M = circular mills of conductor.

Then, allowing 10.5 ohms as the resistance of a mil-foot of commercial copper, and considering a complete metallic circuit, we have

$$C\,M = \frac{15666\ n\ l}{E\ v\ K}$$

Let me give you a practical illustration. Suppose we have a motor the efficiency of which is ninety per cent. at 400 volts electromotive force and when developing ten horse power, and that we wish to transmit this ten horse power 5000 feet from a station, and elect to lose nine per cent. on the line.

Our initial electromotive force will be 440 volts, and we would have

$$C\,M = \frac{15666 \times 10 \times 5000}{400 \times 40 \times .90}$$

or

C M = 54396, which is about equal to a No. 4 B. W. G.

This electromotive force of 400 volts is of very good standard. Without serious inconvenience we can go to 600. For long distance special transmission it is necessary to go up to 3000 or 4000. If the arc light current be used, all motor handlers take the risk of high potentials.

As I have already said, you have to contend against the ignorance of people using motors. It has been said that you can put a motor on an arc light circuit, and it will take care of itself; that the people at the central station will take care of it. This is true to a certain extent, and to an equal extent it is not. I came very near having a serious accident in

New York. I was working on a Brush circuit of 2500 volts. I took hold of the motor and began to adjust the brushes—at first unintentionally and finally intentionally; but it so happened that I was not in a position to be grounded. Had I been so, and there had been a ground on the line some distance away, there would have been an end to my motor experiments. A similar end would have resulted if I had lifted the brushes. We put in an automatic cut-out to avoid that danger. We found that a man blocked the cut-out so it would not work. If that motor and cut-out had any trouble with it (it was on one of the most important Brush circuits in New York—one fifteen miles long) it would have caused the blocking of the entire line.

With a constant potential circuit this kind of trouble is practically impossible. If there are grounds anywhere on the line, or any defects in the motors, they will cut themselves out of circuit automatically, and the rest of the circuit is not affected.

Mr. Sprague here stated that he would be glad to answer any questions members of the Convention might ask, because in that way perhaps he would confine himself to what would be of most pertinent interest.

DR. MOSES: Will you be so kind as to tell us something about the cost of motive power?

MR. SPRAGUE: It is said that in New York City the New York Steam Company is furnishing power to four hundred and thirty-five engines. That power is supplied from a big steam station in Greenwich street. The conductors or pipes used for conveying the steam are, of course, of very large dimensions. The steam when delivered to the engines is wet steam, and the pressure is about 80, or possibly 90 pounds. There is one point of great advantage in the electrical transmission of power, in that you can work at so much higher electrical pressure than you can steam pressure. Then, again, the cost of conductors for electrical transmission is very much less than the cost of conductors for the transmission of steam, and you have not the objectionable element of wet steam. Yet here is the fact that the Steam Company is furnishing 435 engines with power and is making money. The consumers find it cheaper than they can generate their own steam.

We found it necessary in dealing with the various light companies to have certain facts in our possession as to what we could do if we had 500 or 1,000 horse power in a central station; how much power we could contract to deliver; how much could we get for it. The manager of the Edison Central Station in Pearl street, New York, insisted that the meter was the proper means of determining what must be paid for power. If a man uses his motor, the meter registers against him. This was done on our motors. He charged one and three-fifth cents per ampere hour, and he thought he was going to have a bonanza. And he would have had if the motors had not been automatic. After four or five months' running we went to these people and asked them to let us see copies of their bills. We found some curious facts. I will cite one instance as showing the economy of the transmission of power by electricity. There is a firm of chemical dealers, James L. Morgan & Co., 47 Fulton street, New York, who are running a freight elevator. They have a 3 horse power motor working up to 4½ horse power capacity. Their bills average about $12.50 a month; that is $150 per year. Had that motor been used, not up to 4½-horse power capacity, but simply to its normal capacity of 3-horse power, steadily ten hours a day, their bills would have been about $1,200 a year. So you see the average percentage of the time for which they use the motor is less than 15 per cent.

There you have an example of a motor, the people using it as they please, as many hours a day as they please, and they find by their meter bills that they only use that motor to fifteen per cent of its capacity. Now, we took a great many of these cases—printing offices and burnishing machines, etc., sometimes where they ran continuously and where we knew the machine was oftentimes overloaded, and we found this simple fact: that with the whole capacity of motors, they average not over 33 per cent. of their capacity. In no case did we find, where they used their motor without any let up, that their bill was more than 51 per cent. of the capacity of the motor.

Mr. J. A. Powers, of Troy, N. Y., stated that they had started an arc light circuit for the purpose of supplying motors. A very large proportion of the power they would have to supply, would be from five horse down. The difficulty they have met is how to reconcile the first cost of small motors used in parallel distribution on a 600 volt constant potential circuit.

Mr. Sprague stated that with the distances in Troy 600 volt was unnecessarily high. Under suitable electromotive force the constant potential circuit would be found to be the cheaper. He said that he was considering the question of large powers and large areas, and that he was not content to deal exclusively with small powers. The tendency is to increase the powers of motor used. In Boston the motors used were first of one-half horse power; now they are run from twelve to fifteen, and very soon will be higher.

MR. SPRAGUE: As we are building our standard machines, they will run at the same speed, that is within 1 per cent. under all loads up to the maximum. The machines are absolutely automatic. The large machines are of 91 per cent. efficiency. Not only that, but we have machines which run on a potentiality varying from 180 to 220 volts, that is on a variable constant potential circuit, if I may use the expression. In Boston we had one machine built for 110 volts running on 190 volts; in another case a machine for 110 volts was run on a circuit that dropped to 60 volts.

This regulation depends on the winding entirely. A machine wound on similar principles will run at a constant speed on a constant current circuit, but only when working below 50 per cent. efficiency. If working above 50 per cent. efficiency, an automatic mechanical governor is required. No matter what certain English scientific writers may say, it is impossible to wind a machine to run at a constant speed under variable load on a constant current circuit and work above 50 per cent. efficiency.

MR. DUNCAN: We have a 2,500 volt arc light machine. Now, can we run a 45 horse power motor; that is, one machine?

MR. SPRAGUE: No; it would be utterly impossible.

MR. WHEELER: Why is it not as well to run out independent circuits for large powers, and work on constant current circuits?

MR. SPRAGUE: With equal total electromotive force the weight of wire would be the same, but with the constant current you would have a large number of circuits; the regulation would be far more difficult; the advantage of intermittent use would be lost. There are many other objections, but these ought to be enough.

After some further discussion as to the practicability of supplying power from a constant current station (which appeared in full in the REVIEW last week), Mr. Morrison said:

Mr. Sprague takes the ground that a successful motor service should be run from a central motor station. All of Mr. Sprague's argument is that the motor business pays better than the electric light business, and I think he has proven that very satisfactorily by the figures he has given you. But it does not entirely solve the question which is being discussed here—how arc light companies can utilize their surplus current. He told you that if he had a company that had spare power he would use it. There is another thing here—he does not care to deal with small motors. He prefers the larger sized motors, and I think he is very sensible. If you come to one horse motors and one-half horse motors they can be put upon the arc light circuit. If you are going to abandon the electric lighting business and go into the motor business, then take the plan that Mr. Sprague suggests.

Special Meeting of the Electric Club.

DELEGATES TO THE NATIONAL ELECTRIC LIGHT ASSOCIATION GUESTS OF THE CLUB.—"ELECTRIC MOTORS," BY STEPHEN D. FIELD, AND "INSURANCE OF ELECTRIC LIGHT PLANTS" BY S. E. BARTON.

The officers of the Electric Club of this city very properly decided to call a special meeting for Thursday evening of last week and invite the National Electric Light Association, on the adjournment of its Philadelphia Convention, to be its guests at dinner. The Association accepted the invitation and the dinner was announced for 7 o'clock Thursday evening. The adjournment in Philadelphia occurred at 1.30, and by 3 o'clock the large attendance had packed up, lunched, paid their hotel bills and were on a special car en route for this city. The quick way electric light men have of doing things almost paralyzed the hotel staff, but they rallied nobly and the rapid exodus was not delayed. The special car on the 3 o'clock express brought over forty-five delegates—which number in a car of 32 seats made camp stools sell at a premium—and about a dozen came over on the 4 o'clock train. At 7.15, after a social half hour in the rooms of the club at the Hotel Dam, the company, to the number of about eighty, partook of an elaborate dinner. The three large tables were officered as follows: President Davis, of the club, at the head of the center one, with E. R. Weeks, 1st Vice-President of the National Electric Light Association, on his right, and next to him Stephen D. Field, the speaker of the evening; on his left Mr. Ross, of Vienna, and Dr. Otto Moses; at the opposite end presided Mr. Frank Ridlon, of Boston; Mr. Eugene F. Phillips, of Providence, and Capt. H. R. Garden, of New York, presided at the ends of one of the other tables, and Col. Geo. L. Beetle, of New York, and Mr. C. C. Haskins, of Chicago, at the third table. An attempt to photograph the entire company was made, but the light of the gas was not sufficiently intense to make it a success. Among others, New York city was represented by the following named gentlemen:

H. C. Davis, Geo. M. Phelps, Jr., Geo. Manson, Geo. Worthington, Geo. L. Beetle, H. J. W. Dam, H. R. Garden, Stephen D. Field, Dr. Otto Moses, Chas. W. Price, Horace Miller, Jackson Bailey, C. L. Buckingham, Geo. Coggeshall, H. M. Curtis, J. M. Pendleton, E F. Peck, Joseph Wetzler, Geo. W. Wingate, W. M. Callender, A. C. Fowler, C. H. Barney; Kansas City by Mr. E R. Weeks; Boston by Frank Ridlon, A. V. Garratt, S. E. Barton, A. F. Upton, T. B. Doolittle, F. W. Harrington, M. M. M. Slattery, Fred. Swift, W. F. Brewster, A. F. Mason, A. G. McCluer; Philadelphia by Geo. F. Porter, J. Mathews, H. B. Sharps; Hartford by Chas. Dustin, H. M. Linnell; Chicago by C. C. Haskins, and H. A. Glasier; Newark by Messrs. Cyrus O. Baker, Jr., and E. A. Colby; the Administration at Washington by Fred. Royce; then there were Messrs. Stanley and Bancroft, of Bridgeport; Ide, of Springfield, Ill.; Powers, of Troy; Latshaw, of McKeesport, Pa.; Mitchell, of Taunton, Mass.; Daggert, of Attleboro, Mass.; Montague, La Crosse, Wis.; Benj. Rhodes, of Niagara Falls, the sole representative of a water-power that every electric light man envies; Phillips and Robinson, of Providence; Spang, of Reading; R. T. McDonald, of Ft. Wayne, and J. P. Smith, of Peoria, Ill., who arrived a little late; Anderson, of Binghamton; Hyde, of Springfield, Mass.; Pettingill, of Cleveland; and Mr. Ross, of Vienna, who had traveled farther than any one to be present on this festive and instructive occasion. The daily press of the city was represented by Messrs. Fuller, of the *Tribune;* Kellogg, of the *Sun;* Hyde, of the *World;* and others.

It was about 9 o'clock when President H. C. Davis called the Club to order, and stated that the topic for the evening was "Electric Motors," and that Mr. Stephen D. Field would read a paper on that subject. Mr. Field was then introduced and greeted with prolonged applause. He spoke as follows:

MR. STEPHEN D. FIELDS' PAPER ON "ELECTRIC MOTORS."

Mr. President and Gentlemen:

The subject to which I wish to call your attention is the construction and operation of dynamo electric motor systems.

By this I mean that organization of apparatus wherein a stationary steam engine is used to produce dynamo electric currents, and by conversion in dynamo electric motors reproduce the power of the steam engine at distant places.

Almost all the modern dynamos are based upon the inventions of Pacinotti & Attinck and between the relative merits of the two inventors I believe there is no choice; that is, with the same amount of wire and iron equal results either as a generator or motor will be obtained for the same expenditure of power.

Much, however, depends upon the disposition of the wire and iron, an apparent advantage of one system over the other may easily be shown should the two elements not be placed to their greatest working advantage.

A marked analogy is seen between the behavior of a magnetic and an electrical circuit and pole pieces of dynamos are made of greater section than the magnet cores, with a view of diminishing the air resistance between the armature and the field magnets. I believe that lamination of the pole pieces of a dynamo is of benefit in exposing a larger surface from which the lines of force may flow and diminished heating results from this fact, and not from the suppression of Foucault currents, as has been by many assumed. It is difficult to see how Foucault currents could be generated in a piece of iron which is sensibly constant at all points to the flow of a steady current.

In the earliest forms of electric motors direct magnetic attraction and repulsion was employed. Experience with this form of motor shows that the greatest effect is obtained when the armature is polarized to an exact equality with the fixed magnet. A somewhat similar relation of parts can be found in the modern motors. It would seem that the greatest amount of work will be obtained with a given current when the armature and field have equal magnetic strength. I imagine that a great loss occurs when the field magnet does not have a properly polarized armature to act upon.

A good dynamo electric generator is one having the least possible amount of wire on its armature to produce a given current. The best motor is one that has a sufficient amount of wire on its armature to bring it to a magnetic strength exactly equal to the polarization afforded by the field magnet.

Many assume that a slow running motor is a very inefficient contrivance. Such should not be the case. A perfect motor is one which will give the same return for a given amount of expended energy, whether run at ten or one hundred revolutions per minute; that is, for every 746 watts that it receives it will raise 33,000 lbs. one foot high in one minute, no matter what its number of revolutions.

To approximate this result it is obvious that the magnetic pull must increase as the speed diminishes and more iron must be used than has been as yet. Want of iron in the armature is particularly noticeable in motors of the Pacinotti type. In some cases, particularly railway motors, too much iron can hardly be employed.

In an arrangement of apparatus for use on high potential arc light circuits I would arrange a shunt motor, the wire on the shunt having much greater section than that on the armature. I would place these motors in series on the circuit, and by means of a ball or torsion governor cut in more or less of the shunt, as the power called for may require; always preserving such a relation of resistances that magnetic equality between field and armature is assured. By this arrangement only the necessary amount of current to do the work will be taken from the exterior circuit. When the motor is running idle almost the whole current will pass through a very few turns of the shunt,

going on to some other point on the circuit where its energy may be needed.

I am aware that objections have been made to this system of distribution on account of the reactionary effect which seems to occur between different motors on the circuit. This defect, however, is so easily remedied that it ceases to be a factor in the problem.

A great deal of late has been said and written about constant speed motors, self-regulating motors, motors with differential winding, etc., etc. It seems to me that nearly all these schemes amount to using current for the purpose of breaking itself—an arrangement which has about the same mechanical economy as would be obtained in admitting steam simultaneously on both sides of the piston of a steam engine whenever it had a tendency to run too fast.

In the adaptation of motors to railway propulsion we seem to be in the same state that engineers found themselves about the time of the introduction of the locomotive. It really looks as if we never should hear the end of various schemes involving the use of friction clutches, gears, pulleys, chains, belts and screws. As with the locomotive so with the electric motor—there is but one way to practically convey the power, and that is by direct coupling. The necessity for great periphery speed of armature ceases when plenty of iron is used, and in some cases multipolar motors employed.

The brush lead of dynamos and motors is a point upon which there is a wide difference of opinion. Some manufacturers have, I believe, gone so far as to twist the connecting wires back upon the commutator, giving an apparent line of commutation at right angles to the pole pieces, under the supposition that such a position would give an appearance of great efficiency to the machine. When we reflect that the lead is due to the magnetic distortion caused by the opposition of the polarity induced by the current flowing in the armature, to the polarity given by the field magnet, it would seem that a dynamo without brush lead would be a monstrosity.

In a good motor, when in a state of rest, the brushes should have a backward lead of 45°. As the motor gathers speed this lead will become less and less, varying with the speed. If the motor be propelled mechanically, as in the descent of a loaded elevator, the lead will be found to have shifted to a forward position, as in a generator; hence, in variable speed large railway motors automatic brush regulation would seem to be a necessity.

Motors propelled by secondary batteries have yet to prove their position; for railway propulsion they afford a beautiful experiment, but their excessive weight, together with cost of introduction and operation, renders their employment in this service extremely problematical.

You gentlemen who represent the electric lighting interests of the country should make use of your facilities; I doubt if there's a company doing an arc light business that cannot make twice as much in the distribution of power.

Use any of your continuous current dynamos as motors, only put in more iron and balance the magnetism in your armatures and field. Don't waste your time on mechanical gymnastics, but use what you have and are sure of, and the time is not far distant when small steam engines will be unheard of, and large ones only known in localities where cheap fuel abounds. I have with me a drawing illustrating direct connection as applied to a street car, to which I would call attention and invite your criticism.

Mr. President, I have endeavored to confine myself to criticisms, suggestions, and theories which are the result of personal observations. If I succeed in provoking a discussion, which will add to our knowledge of the motor problem, I shall feel that the object of this brief paper has been accomplished.

The discussion that followed Mr. Field's paper was unusually interesting and valuable, and quite generally participated in. A verbatim report will appear in our next edition.

Mr. S. E. Barton, Chairman of the Electric Light Committee of the New England Insurance Exchange, was called out, and addressed the Club as follows :

S. E. BARTON ON INSURANCE OF ELECTRIC LIGHT STATIONS.

Mr. President and Members: I am a diligent worker in my way, in such directions as my ability permits me to go ; but I am a quiet one. I am neither a speech-maker nor an essayist, and were I to launch myself into a discourse on the science of electric lighting I should soon find myself in utter darkness, even in the midst of all of your radiance of arcs and incandescents. But since that body of workers for the common good—the New England Insurance Exchange—has sent me here in response to your cordial invitation, I am told that it is expected of me, representing the interests which I do, that I "read a paper."

My first knowledge of my appointment to represent our Exchange at your meeting was received by me only six hours previous to my departure from Boston on Monday last, and I was only informed since my arrival here that anything was expected of me except to listen and to learn. But since the "powers that be" decree that I must speak, it gives me much pleasure to state some of the results of our experience with electric lights in New England.

The science had gained a considerable foothold in our territory before the formation of our Exchange, and still more, before we were awakened, by somewhat costly experience, to the necessity of undertaking a supervision of the system in relation to the fire hazards pertaining to it.

The so-called "underwriters' wire" (more aptly referred to by my friend, Mr. Haskins, as "undertakers' wire") was in general use at that time, and while we then did, and have ever since, continued to condemn it for purporting to be what it is not—an insulated wire—we knew of nothing to take its place, and therefore we permitted its use, feeling that if you people could afford to take your chances of the loss of energy, we would take our chances of the loss of dollars. We did, however, draw the line against its use inside of buildings and rooms subject to moisture or dampness, in which places we found it to be quite as absorbent as a sponge and possessing about the same insulating qualities as that article does when wet. I remember that my first acquaintance with our mutual friend, Ridlon, was brought about by an instance of this kind ; and we came very near disliking each other. I am pleased to say that he had the manliness to acknowledge, after further investigation into that particular case, that our position, arbitrary as it seemed, tended to our mutual benefit, and since then we have been modern examples of Damon and Pythias.

I am glad, for the sake of our common interests, that the subject of insulation is to receive at your hands the timely and much-needed attention which your action of yesterday indicates.

It is not alone a question of to-day, but one of the future. What will your now poorly insulated circuits become through the deteriorating effects of time and the elements ?

The next most important need, as it seems to us insurance people, is a more thorough and practical knowledge of electrical laws, theories and science, on the part of some of those to whom you entrust the installation and maintenance of your apparatus.

Of course it cannot be expected that every man whom you employ as construction man, dynamo man and lamp trimmer, shall be a professor, but you can at least impart to them a fair practical knowledge, if you will go home and deliver to them one-half of the wise electrical ideas which you exchange here for your own mutual good.

In reference to the question of putting electric light wires underground, I will say that we in New England have never asked it. Nay, more than that, we do not want it. We discourage the concealing of such wires inside the walls of buildings, except in the case of low-tension currents and highly insulated wire; and while we take that position it seems incompatible that we should cry for the whole system to be concealed underground, with all of the possible dangers of molestation which would beset it. It is possible, by substantial and thorough work, to so construct overhead circuits that the liability to contact with other electrical wires or ground connections will be reduced to a minimum. We have found street circuits so built that they would be an obstacle in the way of quick and efficient work by fire departments, thereby subjecting us to greater loss; but we have always found you ready and willing to remedy such defects when you could obtain the necessary privileges from the city or town authorities

In New England, as you perhaps all know, we insist that the various parent companies or "systems" shall reimburse us for the actual expense entailed in the employment and travel of our one inspector. The tax does not fall verp heavily on any one "system," and being levied against them all it works no unfairness to any particular one or more. It is simply an infinitesimal addition to the first cost of your product.

We were once asked, "What benefit does an electric light company derive from being held under contribution by an insurance combination?" Our reply was, that if through that contribution the standard of electric light work was kept at such a degree of perfection that the public felt entire and increasing confidence in it, and that it experienced no opposition, but instead, actual encouragement from insurance companies, we were compelled to believe that the lighting companies did receive a decided benefit. I do not think that if we had cast a disapproving frown instead of an encouraging smile upon the system, there would now be in operation in that little corner of territory more than ten per cent. of all the arc and twenty per cent. of all the incandescent lamps in use in this country; but such is the case, if the statistics are given to me correctly. No, gentlemen, we do not stand in any antagonistic light toward you. On the contrary, we are every day offering inducements for your work, in the shape of reduced rates of premium on our risks—always provided, however, that the work shall have received our inspection and approval. And I know it is the disposition of our Exchange to do even more in that direction than we are now doing, if you continue to give us the same hearty co-operation that you have in the past. I do not think that I need to advance any argument to show that inspection on our part is necessary to attain good results. If I do, then I would point to a case to which I have previously alluded, where the underwriters of a certain State that certainly cannot have in operation more lights than are in New England, and they estimate their annual loss by electric light fires at over two hundred thousand dollars per annum—they do not inspect systematically. But in New England, outside of the city of Boston and State of New Hampshire, we are unable to trace directly to electric light causes more than eight thousand dollars in losses during the past two years, and that sum has been largely on retail stocks of goods where arc lamps have been improperly attended to.

I am particularly struck, gentlemen, with the wonderful unanimity of sentiment in the right direction, and the large amount of good fellowship that I see displayed here among you. I can scarcely comprehend it when I consider with what merciless zeal you "go for" each other in competition, as I have been led to believe you do. But since electric lighting "has come to stay," all this good fellowship, and this semi-annual exchange of ideas and experiences is just as it ought to be. I can only wish you an everlasting continuation of it, and thank you for your patience in listening to me. Allow me, also on the part of the body which I represent, and which is composed of about a hundred good fellows (every one of them), to thank you for this opportunity of finding out that you like us.

The regular monthly meeting of The Electric Club will be held Thursday evening March 3d.

French Dynamos.

The electric light installation at the Hotel Continental, in Paris, was started last week. The incandescent lamps employed are of the Gerard type, and are fitted three or four in series, according to their power, current being supplied by a Gramme dynamo, manufactured by Messrs. Breguet. This machine is shunt wound, and designed to give a maximum current of 400 amperes at 105 volts pressure, when driven at 350 revolutions per minute. It has a total weight of 7 tons. Since its output from the above figures is 42 kilo. watts, equivalent to 56½ electrical horse-power, the makers obtain an electrical horse-power for every 2½ cwt. of materials employed. This can by no means be considered a very satisfactory performance. Most modern English dynamos of that size would give this output with about half the weight, and an output of 1 horse-power for every cwt. of material is not an unusual performance in moderate speed dynamos. Each pole piece embraces only a quarter of the circumference of the armature, and consequently the magnetic field is rather stronger than would be the case were the polar surfaces somewhat larger. According to the figures supplied to us by our Paris correspondent, says *Industries*, the induction in the air space amounts to 8,000 c.g.s. units.

—— Chanute, Kas., has adopted electric lights for street lighting.

—— The Thomson-Houston people are putting in a plant at Newton, Kansas.

—— Hutchinson, Kansas, is now lighted by electricity, having both an arc and an incandescent plant.

—— M. W. Sargent, of Joplin, Mo., will put in a system of electric lighting at that place, for public use.

—— The Reading Electric Light and Power Company, Reading, Penn., have set two more boilers with the Jarvis boiler setting.

—— Wellington, Kansas, is enjoying an electric light war—the Thomson-Houston, operated by a local company, vs. the Excelsior system, operated by the gas company—and prices for arc lights are two dollars per month, with both parties still in the ring.

—— The Edison Electrical Light Company, of New York City, is making preparations to push its central station business all over the country. The success of the Boston Edison central station will lead to the erection of from ten to twelve more central stations in the Middle and New England States, to be constructed on the same system as the Boston station. Great credit is due J. H. Vail, general superintendent of the Edison Company, for the success of the central station in Boston, and the Jarvis Engineering Company for carrying out his plans.

—— The Hudson County (N. Y.) Light, Heat and Power Company filed a certificate of incorporation, with a capital stock of $100,000, divided into 1,000 shares, of the par value of $100 each. The company designs the manufacture, distribution and sale of electricity and fuel gas, for steam, light, heat and power, and the manufacture, sale and supplying of any and all appliances used or required in such business. The incorporators are: Caleb H. Jackson, Pittsburgh, Pa., four shares; Wm. Lee Church, Orange, three shares; Chas. S. Pease, New York, three shares.

——The Western Electric Company are very busy, the Chicago establishment running twenty-one hours per day. Their sales of electric light apparatus is on the increase. On Monday last they received an order from the gas company in the town of Lake for six 30-light dynamos and 180 lamps. This increases the town of Lake plant to 350 lights, Western electric system.

Lowenstein & Co., Memphis, Tenn., for their new business building, the largest dry goods house in the South, a 90-light plant. Winfield, Kansas, 40-light outfit. Louisville, Ky., has ordered additional boards for their multiple system, increasing their capacity to 1,800 lines.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING FEB. 15, 1887.

357,572 Electric heater; W. Leigh Burton, Richmond, Va.

357,576 Electro-magnetic brake; George F. Card, Covington, Ky., assignor to Henry K. Lindsey, Cincinnati, Ohio.

357,627 Cut-out for secondary batteries; George B. Prescott, Jr., Newark, N. J, assignor to the United States Electric Lighting Company, New York, N. Y.

357,646 Galvanic battery and apparatus connected therewith; Alfred R. Upward, West Kensington, and Charles W. Pridham, Kensington, county of Middlesex, England.

357,647 Sanitary galvanic appliance; Peter H. Vander Weyde, Brooklyn, N. Y.

357,659 Obtaining chlorine by electrolysis; Desmond G. Fitzgerald, Akerman road, Loughborough road, Brixton, county of Surrey, England.

357,682 Telephone switch; James W. McDonough and Horace H. Eldred, New York, N. Y.

357,687 Desk for telephone use; Charles A. Patterson, Detroit, Mich., assignor of one-third to John E. Patterson, same place.

357,705 Dynamo-electric generator; James W. Easton, New York, N. Y.

357,726 Electrical circuit; Jacob F. Mehren, Chicago, Ill., assignor to the Western Electric Company, same place.

357,760 Circuit system for electric brakes; Geo. F. Card, Covington, Ky., assignor to Henry K. Lindsey, Cincinnati, Ohio.

357,774 Arc lamp; Vaclav Klan and Francis Spuny, Prague, Austria-Hungary.

357,789 Telegraph sounder; Reuben C. Rutherford, Quincy, Ill.

357,815 Electric burglar alarm; Edward E. Carr, Chalmers, Ind.

357,821 Multiple switchboard; William S. Ford, Denver, Col.

357,838 Electric temperature regulator; Charles E. Lee, Rochester, N. Y.

357,865 Electric alarm and signal bell; Sidney H. Short, Denver, Col., assignor to the United States Electric Company, same place.

357,873 Device for regulating the flow of electric currents; Eli T. Starr, Philadelphia, Pa., assignor, by mesne assignments, to the Electrical Accumulator Company, of New York.

357,881 Electric railway signal; Edward D. Wells, Westminster, Md.

357,885 Electric clock system; Theodore J. Zoeller, Louisville, Ky.

357,922 Electrical signal device; William Hand, Hamilton, and Marcus C. Wright and Francis A. Pocock, Toronto, Canada.

357,960 Electric fire alarm; William L. Horne, Meriden, Ct.

357,976 Car brake; George F. Card, Covington, Ky., assignor to Henry K. Lindsey, Cincinnati, Ohio.

358,002 Electric amalgamator; Theodor H. Trauernicht, Lead City, Dak.

BUSINESS NOTICE.

Notice is hereby given, that the co-partnership heretofore conducted under the firm-name and title of VALLEE & BRO., at 1210 Market street, has been dissolved by mutual consent, and that a co-partnership between the undersigned has been this day formed under the name and style of VALLEE BROS. & CO., at 932 Arch street, for the purpose of manufacturing and dealing in electrical supplies, and the construction of electrical and pneumatic work of every description. We respectfully ask a continuance of your patronage.

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Philadelphia, Jan. 15th, 1887.

BUSINESS NOTICE.

"In making the statements which follow we can verify each and all of them as facts. Mr. Edward P. Thompson, of Temple Court (7 Beekman St.), New York, is a good man to bring your patent cases to, for he is thoroughly versed in all the ins and outs of a Patent Attorney's duties. The following are some of his qualifications: Graduate of Stevens Institute as Mechanical Engineer. For four years tutor of classes of young men in mathematics and experimental physics at Elizabeth, N. J. Served professionally as Electrician and Chemist in the Swan Electric Company of New York for two years. Because of past successes as a Patent Attorney at 13 Park Row, New York, was appointed to succeed N. S. Keith, of the patent agency of the *Electrical World* and Associate Editor. N. S. Keith is known as the Translator and Reviser of Schellen's Treatise on "Dynamo Electric Machinery." Mr. Thompson for two years personally prepared and prosecuted all the patent business of *Electrical World's* Patent Agency, and is the author of a series of articles in said paper upon "Analytical and Systematic Method of Inventing," which were widely known and favorably received. Mr. Thompson is a member of American Institute of Electrical Engineers and American Society of Mechanical Engineers. He is author of the "Expansion of Polynomials," which the ablest mathematicians of the world universally commend." —*New York Observer*.

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Thomson-Houston Electric Light, Herbert Wadsworth, Manager Western Office.
Brush Electric Co., Alex. Kempt, Special Agent.
Excelsior Electric Co., C. J. Reilly, Western Mgr.
Sperry Electric Light Motor & Car Brake Co., 201 Royal Insurance Building
J. H. Reid, General Manager of the Mather Electric Light Co., Chicago.
Wm. H. Purdey, Comm. of Public Works, Chicago.
John Mab, Chief Engin'r of Board of Trade, Chic.
C. J. Meimes, Gen'l Sup't Thomson-Houston Light, Omaha, Neb.
J. A. Corbey, Sr., Joe Electric Light and Power Co., St. Joe, Mo.
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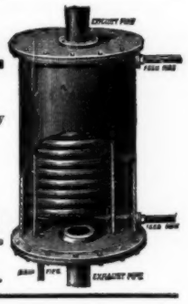

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Fig.259

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Fig.255

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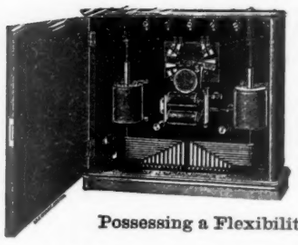

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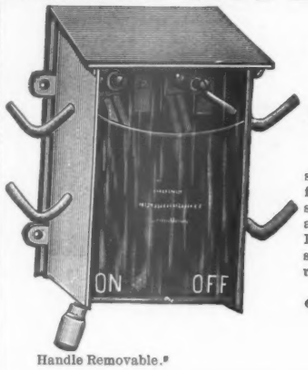

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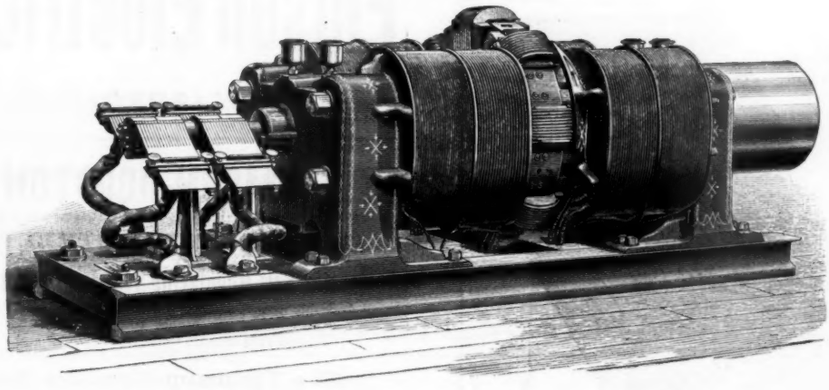

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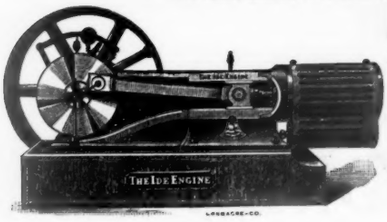

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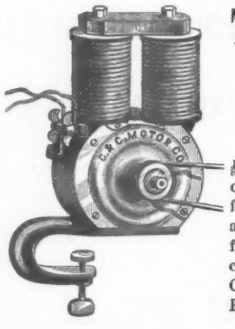

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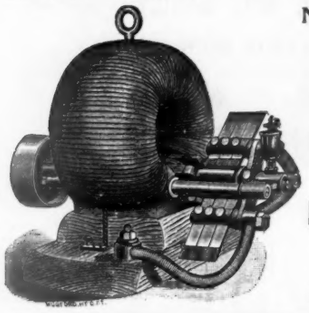

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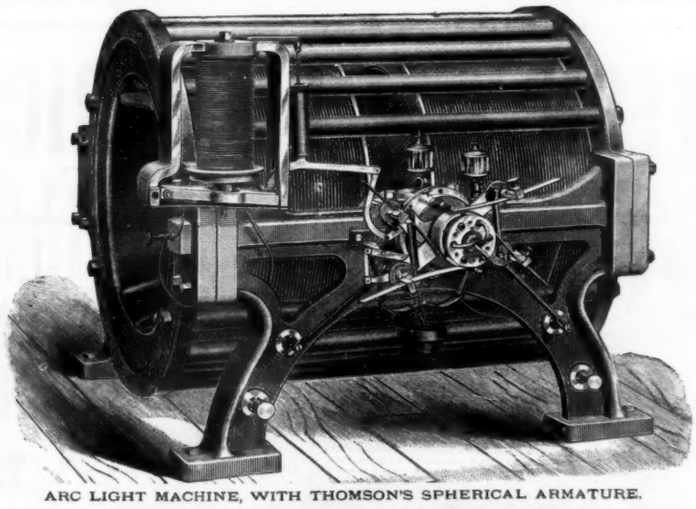

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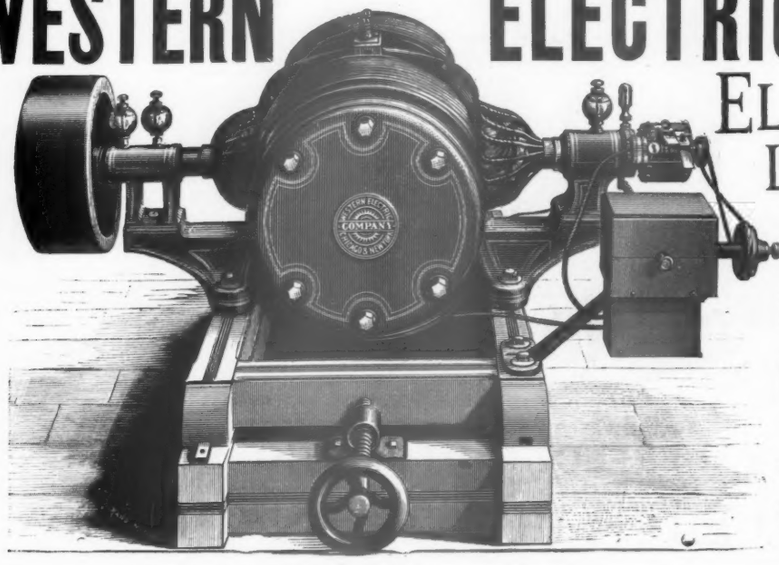

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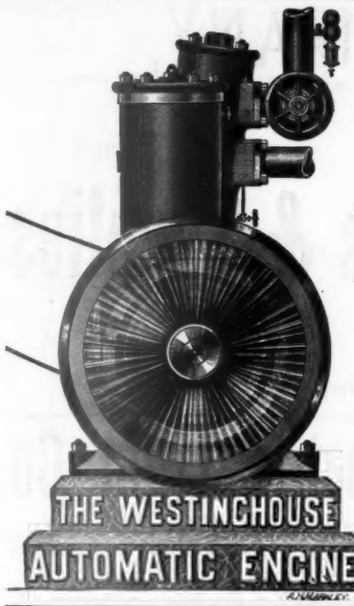

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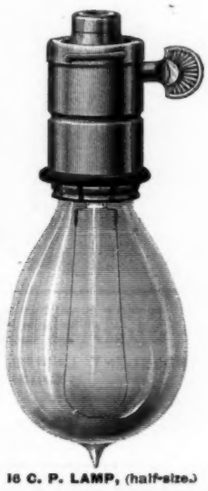

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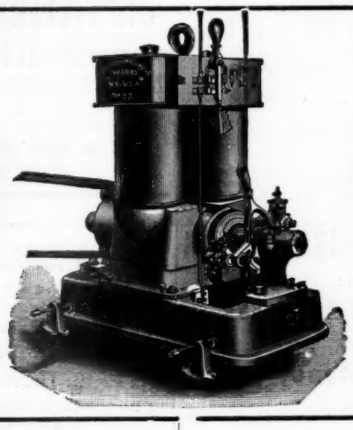

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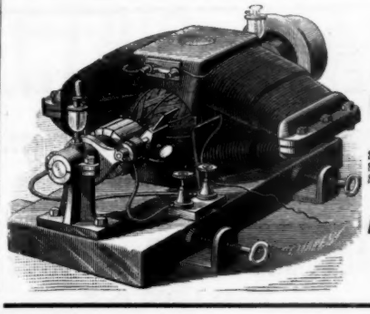

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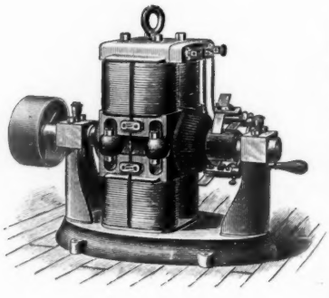

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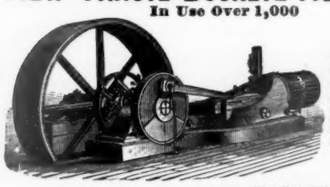

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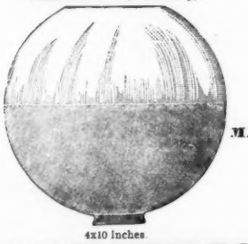

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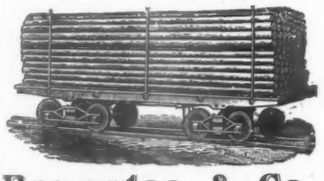

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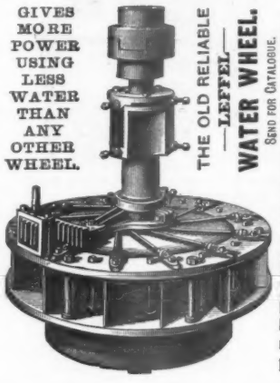

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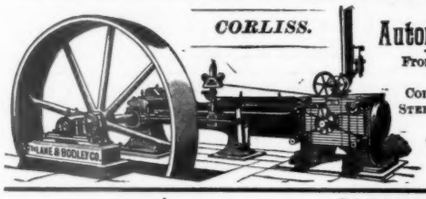

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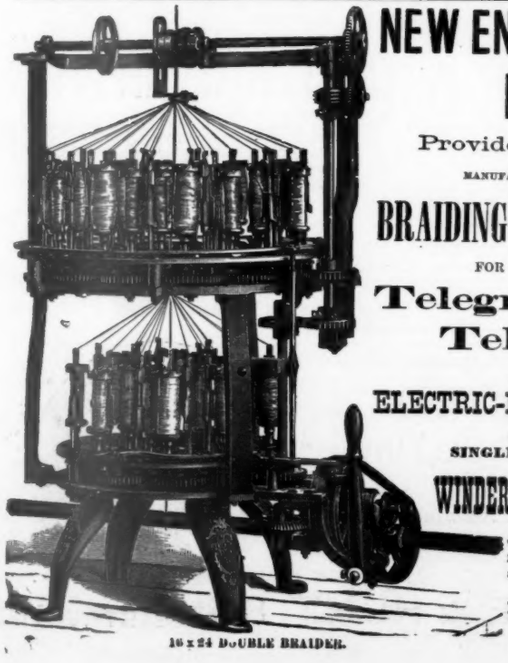

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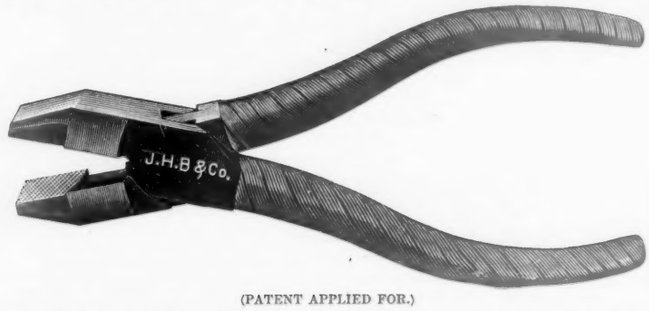

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